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ELECTRICAL WORLD AND ENGINEER.

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THE AMERICAN STREET RAILWAY ASSOCIATION.

Elsewhere we print abstracts of some of the papers read this week at the St. Louis Convention of the American Street Railway Association and its affiliated societies, and a telegraphic report of the proceedings of the first two days of the convention. Both in attendance and interest the convention promises to be one of the most successful of recent years, and if the movement for the reorganization of the association to which the telegram refers succeeds, the St. Louis meeting will take rank as one of the most important—perhaps the most important—in the history of the body. That some step was called for that would put new life into the association, broaden its activities and bring it thoroughly up to date, has for some time been apparent. The present situation is somewhat similar to that which confronted the National Electric Light Association a few years ago, from the dangers of which an escape was found through a change of policy leading to the introduction of new ideas and of new men. The latter, like the Railway Association, had changed little in character or in membership from the early days of its career, notwithstanding the revolution which had taken place in the art it represented, and an almost complete change in its personnel, with the result that it was approaching the status of an "Old Timers'" association.

What appears most defective at present in the conduct of the railway organization is lack of attention to the important technical and engineering developments affecting the art, with accompanying subordination, amounting practically to elimination, of the professional element; the administrative side of the industry has thus far absolutely dominated, with the result that the scope of the association has, more particularly of recent years, been confined largely to the managerial field. That the problems in this particular field are of vital importance none, of course, will deny; but an association representing an industry as a whole should, it would seem, extend its activity over every department that is a factor in success in the present or progress in the future. None will, we believe, maintain that of recent years the proceedings of street railway conventions have, either in character or variety of papers presented, in discussions, or in the work of committees appointed to consider special problems, been fully equal to the duty owing to the industry for which it stands. How long the prestige of the past would sustain the association if continued along its present lines, is problematical. Judging from the telegram printed elsewhere, the movement toward the reorganization of the association involves the merging into it of the affiliated society to which had been delegated the consideration of the purely technical side of the industry, which is unquestionably a wise plan.

SUFFOCATION IN RAILWAY TUNNELS.

It would be a curious avoidance of making an obvious comment, if an electrical journal did not direct attention to the recent sad disaster in the St. Clair tunnel on the Grand Trunk Railroad, between Sarnia and Port Huron, Mich. A freight train was being taken through the tunnel and parted. It was a foggy and thick night, there was no draught through the tunnel, the gases from the anthracite burning locomotives had accumulated, and the trainmen were soon overcome by the poisonous atmosphere. Before the train could be cleared and after a series of exciting incidents, no fewer than six men were killed by the gas, and but for the bravery of one rescuer, it might have been even worse.

One rubs one's eyes on reading of such an occurrence and wonders why the electric locomotive was ever invented, and whether the Grand Trunk Railroad has ever heard of it. For years past there has been no single reason in the world why steam locomotives should any more be used in long tunnels. Presumably, however, this will not be the last of such "accidents" in the St. Clair tunnel.

THE ELECTRIC CHARGE OF THE SUN.

Among the many interesting topics covered by Section A papers at the International Electrical Congress at St. Louis was "The Electric Charge of the Sun," a paper contributed by Prof. Dr. Svante Arrhenius. Starting with the now well-known principle, first enunciated by Maxwell, that light exerts a pressure in the direction of its motion, the paper points out that the repulsion of comets' tails from the sun, which so long baffled comprehension, is now readily understood. The total gravitational force of the sun's attraction upon a given mass of matter, say a gram of hydrogen, is the same whether the gram is collected together into a dense compact mass, or spread out over a very large volume. But the pressure of light upon the gram mass depends upon the surface area illumined, and is extremely small when the gram mass is densely compacted, but may be relatively large when the mass is distributed over a large area. In fact, when the diameter of any spherical particle of totally reflecting matter of unit density is 1.5 microns, the particle will be in a balanced condition of force toward the sun at any distance therefrom, the gravitational attraction being equilibrated by the radiant repulsion. For spherical particles larger than 1.5 microns in diameter (sixty millionths of an inch), gravitational attraction will preponderate; while for smaller particles repulsion will overcome attraction, as far as the diameter 0.008 micron, for which at unit density, the sun's radiant repulsion would probably be 2.5 times as great as his gravitational attraction.

It is suggested that when an eruption occurs on the surface of the sun, negatively electrified particles are hurled far off into space, of a size so small that they are repelled by light more than they are attracted by gravitation. If the resultant repulsive force were just equal and opposite to the ordinary gravitational attraction, it would take 68.7 hours, or nearly three days for the negatively electrified particle of sun to reach the earth. Again, if the resultant repulsive force was 1.5 times as great as gravitational attraction, the duration of the journey to the earth would be reduced to 45.9 hours, or approximately two days. The exact length of time would vary with the size and nature of the particle. As soon as the stream of negatively electrified particles reached the earth, the effect would be equivalent to an electric current penetrating into the atmosphere from above, accompanied probably by auroral display and by disturbances of the magnetic field amounting to what is called a magnetic storm. Observations by several different observers seem to indicate that a magnetic storm on the earth follows any violent eruption on the surface of the sun, by an interval of time of nearly two days (42.5 to 45.9 hours) after the sunspot comes directly opposite to the earth, an interval agreeing well with the above calculation.

By shooting off negative electrons into space, the sun must tend to become positively electrified in corresponding degree, and electrostatic force will aid gravitation in attracting the negatively electrified particles. When the sun's positive electrification became sufficiently great, the negative electrons would be attracted by gravitation and electric force more powerfully than they were repelled by light and the shooting off into space would stop. Moreover, all negatively electrified particles within a large range, say one-tenth of the distance of the nearest fixed star, would be drawn into the sun, thereby tending to reduce its positive charge. According to this view, therefore, the sun is a large alternating electric machine in which the period of alternation is about eleven years. During the period there is first a shooting off into space of electrons with an increasing resultant positive charge, and then a recoil or an absorption back from space of negative particles, with a diminishing charge. The earth, as a target, receives a part of the negative shower, and in its consequent electromagnetic phenomena naturally give evidence of the same eleven-year cycle, as observed.

THE MAGNETISM OF THE EARTH.

The International Electrical Congress paper, by Dr. L. A. Bauer, in Section A, forms an important contribution to the textbook literature of the earth's magnetism. The study of the earth's magnetism is the oldest magnetic research on earth. It is a wonderful riddle and several centuries have successively made guesses at it without much success. Nevertheless, the nineteenth century accumulated a large mass of information concerning the superficial distribution of the earth's magnetism. A number of sets of magnetic charts have thus been produced, for different periods of the century, showing the declination, inclination and intensity of the earth's magnetism at nearly all parts of the world except near the two poles. Curiously enough, the magnetic observations accumulated over the ocean-covered areas of the earth have fallen off in number and in precision during the last half century, owing to the general adoption of steel vessels, on which the large local deviation of the compass needle, due to the ship's magnetism, makes accurate measurements of the earth's magnetic field at sea almost impossible. The steel vessel has driven the natural magnetic field off the sailor's path as completely as the trolley car has driven the magnetic observatories on land away from the haunts of civilized man.

The paper points out that it is not difficult to show that much the greater share of the earth's magnetism has its origin underground rather than above the ground. It has been shown that electric currents or magnets outside the earth can have very little share in the magnetic distribution at the surface which is marked on our charts. The analysis made by Gauss and others since his time of the earth's magnetic distribution indicates that about two-thirds of it is such as would correspond to a simple homogeneous magnetization of the earth's mass about an axis of symmetry which is also a diameter of the earth and inclined to the polar diameter by a moderate angle. This homogeneous magnetization has been called the primary magnetization and the share of the total evident magnetic field due thereto—the primary magnetic field or the principal magnetic field. The residual magnetization and magnetic distribution seem to be closely related to temperature distributions in and over the earth's surface. Curiously enough, a comparison of the latest magnetic observations with those made about 1840 or 1850, seem to indicate that the earth's magnetism has fallen off about three per cent. during the interval intervening. The shrinkage is unexplained. If it really existed and were to continue, the earth's magnetism would almost entirely vanish in a few thousand years.

A small part of the earth's residual magnetic field appears to be due to external radial currents, i. e., electric currents passing either from the earth's surface upward into the atmosphere and beyond; or, oppositely, downward from the atmosphere down to the earth. By the application of the well-known magnetic principle that the curl of magnetic force around any area is equal to 4π times the surface integral of electric current through the area, it has been

shown that there is generally a very appreciable vertical current component to or from the earth. In other words, the curl of the magnetic force around any given territory does not in general vanish, as it should if there were no vertical electric current distribution through the territory, but leaves a distinct residual quantity, positive in some regions of the earth and negative in others. The corresponding average distribution of current reaches a maximum of about forty milliamperes per square kilometer, either upward or downward. The paper shows that in a general way this vertical current distribution appears from the computations to be upward over those regions of the earth near the equator and elsewhere over which the atmospheric currents are known to be rising; and that similarly the electric currents appear to be downward where the atmospheric currents are generally descending. Consequently, it may be possible to account for the vertical magnetic component in the earth's residual distribution by the convective transportation of positive electricity upward or downward in the general atmospheric circulation.

The Problem of Distribution.

This topic was the subject at the International Electrical Congress of three polemical papers and a vigorous discussion. We have already abstracted these, but the situation appears to call for some comment. To our minds the papers were interesting as examples of special pleading but very far from convincing. Around them still lingered some of the old sulphurous odor of the discussions of fifteen years ago. The *odium theologicum* still comes to the surface as the discussion waxes warm. The participants in this particular case were Messrs. Torchio and Dow and Dr. Stern, of Vienna. All three performed the somewhat sophistical feat of adjusting the conditions presupposed to fit the point of view chosen, to the improvement of the respective arguments, but to the irreparable damage of any generalized conclusions. To begin with, Mr. Torchio chose a hypothetical plant fitted out already with two-phase generators, series direct-current arcs and a 500-volt motor service—by no means an impossible case, but not one well suited for typical treatment. He also assumes a somewhat heavy motor service as inertia against polyphase distribution with its attendant change of motors, and in discussing polyphase systems glides genially around the one which would be chosen by many engineers familiar with alternating work, shutting his windward eye the while. Dodging the three-phase, four-wire arrangement, notoriously the most economical of copper and the easiest of regulation of the three-phase distributions, he brings comfortably up with a fine flourish at the goal. On the other hand, Dr. Stern marshals a brigade of somewhat shaky hypothetical objections against direct-current distribution, minimizes the motor situation, invokes the osmium lamp as a forerunner of lower lamp voltages, and deftly side-stepping various difficulties, brings up at that fearfully and wonderfully made thing—a house-to-house transformer system with low-voltage secondaries.

Mr. Torchio, too, kow-tows to the osmium lamp as a shield against the slings and arrows of the double-voltage incandescent lamp and the Nernst glower. Apparently neither gentleman has cared to take the trouble to inform himself about the metallurgy of osmium and the supply of that scanty by-product of platinum ores. Mr. Dow has drawn an excellent brief as the apologist of things-as-they-are. Frankly, we think there is much to be said for his point of view. The fact is that the direct-current system of the three-wire type had early obtained and has maintained so firm a grip upon American city practice that it would be extremely difficult to shake off even if one admits that it would be desirable to do so. So much money has been long invested in such plants, and they have through improvement and consolidations been so heavily capitalized, that wholesale change would have to justify itself by a larger showing of increased earnings than it would be easy to prove for any system yet advanced. Moreover, these fine strong systems are earning good dividends as a rule, and if they could by radical changes make an extra five per cent., would probably have difficulty in holding out against pressure for the reduction of prices. They meet their difficulties of distribution symptomatically, and while the result in our opinion is generally less economical than could be reached by alternating currents alone were the system organized *de novo*, they are far from bad results. There is no assignable reason why an alternating-current system, either polyphase or monophase, should not, upon the whole, give as good service, as good regulation as and better efficiency than a pure direct-current plant or any of composite plant. Neither direct nor alternating currents alone can meet every possible requirement of customers. Either can meet so many of them as to leave only small residual demands that form no adequate excuse for separate distribution systems. Whenever necessary the systems can be interchanged locally and in view of this they need not be otherwise interchanged.

To take up some concrete cases. The backbone of the electrical supply service is the incandescent lamp. This is the limiting factor in distribution voltage by direct current or in the secondaries with alternating current. There is no doubt whatever that from 100 to 125 volts the present lamps are excellent. There is small reason to suppose that they would do much better at 50 volts, and it is certain that they will not do quite so well at 250 volts. Our English friends use very large numbers of the "double-voltage" lamps and find them good at about 3.5 watts per candle. This is about 11 per cent. worse than our regular 3.1-watt lamp, but within certain values of the radius of distribution, the saving in copper probably outweighs this disadvantage. In any given station it is merely a question of fact as to the particular conditions that would or would not make high-voltage lamps desirable. On the other hand, the use of 4 or 6-cp lamps for display work would undoubtedly be much easier at the low voltage which can readily be obtained on an alternating system. It is quite true that an alternating arc is less efficient than a direct-current arc consuming the same energy at the arc; but people who live in glass houses shouldn't throw stones, and objections to alternating arcs come with very ill grace from purveyors of 3.5-amp., direct-current arcs taking 420 watts per lamp and working at 3.4 watts per mean spherical candle-power. The fact is that ours is a changing art and one must be very cautious in drawing hasty conclusions. Each special case that comes before the engineer calls for study of the controlling conditions of economy, and he who ties himself fast to a "system" will be responsible for pretty bad results now and then. Comparatively small changes in apparatus may make profound changes in method. The Nernst lamp is a standing menace to direct-current distribution, and if the Cooper Hewitt rectifier should chance to arrive, the engineers who have industriously boomed alternating-current motors would go around kicking themselves—and so it goes. Our American city practice, however, promises for some time to be direct current, barring such contingencies, in virtue of what already is. If at any time a company gets a clear field for a great new plant, that plant will almost undoubtedly use alternating-current distribution. The figures given by Dr. Stern for the two great Vienna plants are immensely striking, and exorcise them as you may, they still will rise to haunt the dreams of the old-line engineer. Business is business, and if energy can be delivered by alternating current at a saving of one-third as against a five-wire, direct-current system, the fact will not down.

St. Louis Convention of the American Street Railway Association.

(By Telegraph.)

The St. Louis Convention of the American Street Railway Association was opened on Monday morning by the meeting of the affiliated American Railway Mechanical and Electrical Association. The attendance at the convention, which promises to be unusually successful in every respect, is large. An innovation is the presence of a band brought from Providence by the Manufacturers' Committee, which gives concerts daily in the grounds and on Monday night gave a concert at the Southern Hotel. There is a strong movement on foot having in view the reorganization of the association, and it is expected that on Wednesday President Ely will outline a plan to accomplish this. One of its features will be the merging of the affiliated American Railway Mechanical and Electrical Association with the parent body.

The Manufacturers' Committee on Monday re-elected Mr. Daniel Brady as chairman and increased the membership to fifteen. All of the old members, ten in number, were re-elected and the following new members added: Wharton, Philadelphia; King, Ohio Brass Company; Randall, National Electric Company; Whiteside, Allis-Chalmers Company. The remaining vacancy will be filled during the week.

On Tuesday the following officers of the American Railway Mechanical and Electrical Association were elected to serve the ensuing year: President, C. F. Baker. Vice-presidents—H. H. Adams, Baltimore; J. Millar, Buffalo; Fred G. Simmons, Milwaukee. Executive Committee—B. F. Carver, Newark; J. S. Doyle, New York; C. C. Lewis, Schenectady; W. H. McAloney, Denver; secretary, W. Mower, Detroit.

The sessions of the American Mechanical and Electrical Association were opened on Monday morning with President E. W. Olds in the chair. Mr. John I. Beggs, president and general manager of the Milwaukee Electric Railway & Light Company, delivered an address in which he laid stress upon the necessity of a railway organization such that all parts would work well together like a well-designed piece of mechanism. He considered that the duties of the master mechanic are of extreme importance, his functions being practically those of an assistant manager. Referring to the paper of Mr. John Lindall, which was read later (an abstract of which appears on another page), and of which he spoke in high terms, Mr. Beggs said that it is desirable in accident cases to have data on record showing that the cars were in good condition at the time of an accident. He considered that there are many problems in connection with street railway equipment yet to be considered and particularly with respect to the controller. Mr. Beggs recommended the consolidation of the Mechanical and Electrical Association with the parent body and the reorganization of the latter. Mr. W. Caryl Ely, president of the International Traction Company, of Buffalo, N. Y., then addressed the association. He spoke of the possibility of the parent organization taking over the Electrical and Mechanical Association and paid a high tribute of the importance to an electric railway system of the master mechanic.

Secretary Mower then made his report, which showed a membership of 150, with a surplus of $400 in the treasury. Mr. Fred G. Simmons, superintendent of way, Milwaukee Electric Railway & Light Company, reported that trackmen were desirous of joining the association and by a unanimous vote the by-laws were changed to permit this addition to the membership.

In the afternoon Mr. W. D. Wright read his paper entitled "The Ideal Shop." He laid down as a primary condition efficient lighting and recommended two one-story buildings on either side of the transfer track, having a depth sufficient to accommodate two double-truck or three single-truck cars on a track. He advised brick construction with plank roof covered with fine gravel, and a cement floor. In the discussion the relative advantages of overhauling in a pit or from above were considered. Several members recommended an open space between shops to reduce the fire risk. Mr. W. A. Mundy suggested a location whereby the shop tracks would make an angle of 45° with the main track. The next paper was that of Mr. J. Millar entitled "Wheel Matters." He condemned chilled iron wheels. On his road—the International Railway Company, Buffalo, N. Y.—rolled steel wheels and steel-tired wheels are used. The former have given very fair results, and while the latter have not been long in service, apparently they will give good results. In the discussion it was developed that many roads are now trying steel wheels.

At the session on Tuesday morning a paper by Mr. John Lindall, general foreman of shops of the Boston Elevated Railway Company (an abstract of which appears on another page) was read by Mr. Alfred Green. In the discussion Mr. W. Pestell said that he thought reporting of defects is very essential and should preferably be done on cards having blank spaces for all necessary items. He did not agree with Mr. Beggs as to the advisability of merging the association with the parent body, for while the work of the Accountants' Association is nearly finished much still remains to be done in connection with railway mechanical problems. He made an urgent plea to railway managers to put copies of the technical papers read before the association in the hands of their principal mechanics. He recommended multiple control for interurban cars in order to get the controller off the platform. The question of the education of motormen was then discussed at length. The most of those taking part recommended that motormen be required to file a daily report of defects, not going into details beyond those sufficient to serve as a guide for repairmen. After the appointment of a committee on cars and car equipments, the shop, car stations, track and block signals, the association proceeded to the election of new officers.

American Visit of the Iron and Steel Institute.

One of the last "foreign" societies to visit the United States this year is the Iron and Steel Institute, of London, of which Mr. Andrew Carnegie is president. In numbers its delegation of 350 will be one of the largest this exposition year. The body visited this country in 1890, and the members from what they have heard are inclined to believe that there may have been some progress in the fourteen years. Elaborate preparations are being made for their reception and entertainment. Secretary Bennett H. Brough has arrived this week and has issued a preliminary programme.

It is expected that most of the members will arrive in New York on Friday, Saturday and Sunday, October 21, 22 and 23. The headquarters will be at the Hotel Astor, at Forty-fourth Street and Broadway. For the entertainment of the members during their three days' stay in New York a local reception committee has been formed, including the following gentlemen: James A. Burden, chairman; G. W. Maynard, vice-chairman; Stephen W. Baldwin, chairman finance committee; L. W. Francis, chairman invitation committee; C. A. Moore, chairman reception committee; E. E. Olcott, chairman transportation committee; Thomas Robins, Jr., chairman entertainment committee; T. C. Martin, chairman banquet committee, and Dr. R. G. Moldenke, secretary.

The New York committee has arranged for optional excursions on October 24 to electric lighting and electric railway power houses, bridges, industrial establishments, universities, the Navy Yard, the new Rapid Transit Subway, and other places of interest in New York, with boat trips around the harbor and drives in the parks for the ladies of the party during the morning and afternoon, with the opening of the annual general meeting of the Institute in the evening, followed by a reception. At this meeting addresses of welcome will be delivered, and on behalf of the council Sir James Kitson, past-president, will present to the president, Andrew Carnegie, the Bessemer gold medal in recognition of his great services to the iron and steel trades of the world.

The daylight hours of October 25 will be devoted to an excursion up the Hudson River on a special Sandy Hook boat loaned by the Jersey Central Railroad Company, stopping at West Point.

In the morning and afternoon of October 26 there will be two meetings of the Institute, when a selection of papers will be read and discussed. In the evening the Institute will give a banquet in the grand ballroom at the Waldorf-Astoria. For this evening a theatre party is to be arranged for the ladies accompanying members.

For the reception of the Institute during its stay in America an influential general committee has been formed, John Fritz, Bessemer gold medallist of the Iron and Steel Institute, being the president; Charles Kirchhoff, the chairman of the executive committee; Robert E. Jennings, treasurer, and Theodore Dwight, secretary. Mr. Bion J. Arnold is one of the vice-presidents of the committee. Mr. John W. Lieb, Jr., president of the American Institute of Electrical Engineers, will represent that body officially at the banquet. After the New York reception, the members will visit different parts of the country, including Schenectady, Niagara, Pittsburgh, St. Louis, Washington, etc.

On Turbo-dynamos.—III.

BY PROF. F. NIETHAMMER, PH.D.

IN this concluding article will be described the various designs of turbo-dynamos taken from actual practice, mainly of continental European concerns. The leading concern in steam turbine and turbo-dynamo practice in Europe is undoubtedly at present Brown, Boveri & Cie., Baden, Switzerland, and the leading designer, C. E. L. Brown, with whose engineering work the readers of the ELECTRICAL WORLD AND ENGINEER have become already familiar through Behrend's papers. I hope to add another leaf to this paper on the debt we owe to C. E. L. Brown, reporting on his most recent designs of turbo-generators of the three-phase and the direct-current type. The workshops of Brown, Boveri & Cie. are simply overcrowded with steam turbines and the corresponding electric machinery under construction. Hundreds of three-phase turbo-generators are already in regular and satisfactory service, six sets of 10,000-hp, three-phase units are soon to be completed, about seventy direct-current turbo sets are running already and a 2,000-hp[1], direct-current turbo-dynamo is now under construction. So Brown, Boveri & Cie. take, according to my knowledge, the first place in the whole world as to size of units and as to quantity of generators built in this new branch of engineering.

By the courtesy of Mr. C. E. L. Brown, I am able to give a description of the highly interesting development of Brown's turbo-alternators and direct-current generators. With most firms the turbo-generators are of an ever-changing design, two consecutive machines never equal to each other, though the period of designing this type of machinery has been very short. Brown hit the nail right the very first time. The first design of Brown's rotating field[2], laid out in 1901, has proved a complete success and did not need

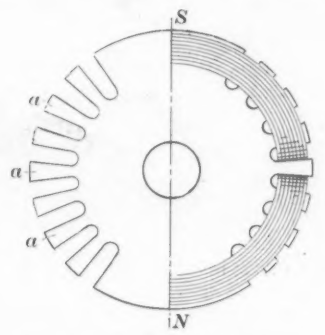


FIG. 1.—SECTION OF FIELD CORE.

any essential change. From the very outset Brown was convinced that all usual field constructions, even the copper strip on edge, which in 1892 he had first proposed for the Niagara generators, could not successfully withstand the high centrifugal forces of turbo-generators which have only very few poles (mostly 2 or 4) and, therefore, very heavy and bulky field coils. These coils must be subdivided, and all single parts of them have to be fastened individually. The radial depth of these separate coils must be low, in order to insure that they do not change their original position with regard to the shaft, as this would eventually throw out of balance even the best constructed machine. The outcome of this reasoning is shown in Fig. 1 (Swiss patent No. 25,338, German patent 138,253); the field winding is spread in a great number of slots similar to a direct-current armature winding. The slots may be open, semi-closed or entirely closed. The usual way of manufacturing is to be seen by reference to Fig. 2: A cylindrical body of the best solid steel, *a*, is first provided with circular grooves, *b*, which are used as ventilating ducts cooling the field coils and driving the air through the stationary part and the induced winding. The next process consists in milling axial slots, *c*, in which the machine-wound field coils are imbedded, and which are closed by strong wedges of a special non-magnetic bronze (brass or aluminum). A special insulating wedge is not necessary, the exciting voltage being very low, 20 to 100 volts. As field conductor a flat copper strip, which is well insulated, is chosen. The various coils are carefully soldered together on the end connections, which are kept in place by a cylindrical cap manufactured from a special bronze and fastened in grooves of the field body (Fig. 2 *c*) and on the shaft. The inside of the bronze caps are well covered with insulating material, against which the end

FIG. 2.—FIELD CORE IN PROCESS OF MANUFACTURE.

connections are pressed by their own centrifugal force, when running. The wings cast on these bronze caps produce a strong artificial draught which is necessary to cool machines of such reduced dimensions (see my articles, I and II). The described magnet field with definite poles differs from usual pole constructions by the fact that between the separate field coils of the same polarity project iron teeth, which might give rise to disagreeable stray fields. Careful tests have proven, however, that there is no advantage in replacing the iron teeth by non-magnetic material, and that this field arrangement is magnetically fully equivalent to a usual field, and is mechanically by far the most rational and cheapest design.

For large fields Brown uses laminated sheet iron assembled on a steel shaft instead of the solid iron field, but the whole design remains unaltered. A good view of a finished field body is reproduced in Fig. 3. It is a well-protected and well-ventilated *smooth* body,

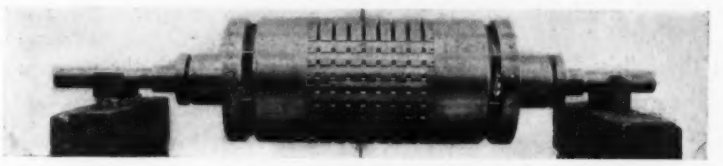


FIG. 3.—COMPLETED FIELD STRUCTURE.

which runs without noise, as it possesses no projecting parts to give rise to air whirls. On each side a slip ring of hard cast iron (steel) is fastened on the shaft. The brushes are, as a rule, wound up of very thin compressed brass sheet (brass leaf). All the several parts of the field (Fig. 2) core without slots, core with slots, core with winding, finished core, are separately balanced; the holes in the bronze caps serve also for the purpose of balancing.

In Fig. 2 it may be noticed that the long steel central core is provided with a hollow hub on both sides. The shaft of the best steel, consisting of two square pieces, is pressed into these holes of the field body. The axle-bearing boxes (Fig. 4) are split and are sup-

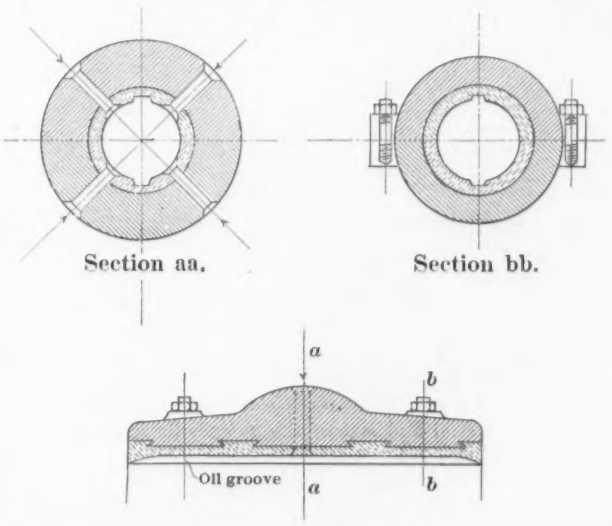


FIG. 4.—AXLE BEARING BOXES.

ported on spherical surfaces, into which the lubricating oil is passed through four radial holes under a sufficient pressure. There is only one oil groove in the upper and lower half of the journal box, which groove runs in a straight axial direction and diminishes gradually in depth. The two halves are screwed together, not pressed together

[1]It is a well-known fact that there is no need for larger direct-current units than about 1000 to 2000 horse-power, as larger outputs are exclusively reserved for alternation. The General Electric Company offers f. i. direct-current turbo-dynamos only from 1½ to 500-kw. and turboalternators from 500 to 5000-kw.

[2]The very first turboalternator built by Brown, Boveri & Cie. had a rotating armature for low voltage similar to the original designs of Parsons. To be quite correct, one has to start with Brown's second turboalternator.

by the cover, as is usually done. There is a large oil reservoir surrounding the pivot, to which all waste oil flows, to be collected under the turbine in a large tank, in which it may be artificially cooled by a water coil. It may be mentioned here that the foot-step bearing of the Curtis turbine supporting the rotating elements of the turbine and the generator is lubricated by oil forced between the bearing plates flowing from the central outward in a thin film, separating the rotating and stationary circular bearing plate by about 0.005 in. of oil.

The stator or induced part of Brown's alternators differs but slightly from his usual construction, except that it possesses somewhat greater length—one meter or more. It necessitates, of course, special care in the workshop to assemble such long laminated bodies and to press them solidly together. In fact, the pressing is done in parts, that is, lots of about 100 or more sheets are first packed and screwed together and from these finished parcels the whole body is built up in such a way that the main bolts need not withstand the elasticity of all sheets. The slots of the stator are either open with form-shaped coils, or nearly closed with hand-wound coils or with bar winding. The slots are usually protected by seamless mica tubes[3]. Even with open slots the field body is solid, as a rule, the air-gap being rather large (8 to 15 mm.) and the number of slots per pole and phase being very high.

The shape of rotating field just described is regularly used for sizes from 100 kw, 3,000 r.p.m., up to 6,000 kw, 750 r.p.m., and dozens of them are just now to be seen in Brown's shops under construction. For further illustration I give below the characteristic diagrams (Fig. 5) of a three-phase Brown turbo-alternator of 1,500 kw, 1,500 r.p.m., 50 periods, 3,500 volts. Curve 1 is the short-circuit current (abscissæ exciting current), curve 2 is the no-load e.m.f., curve 3 the full-load e.m.f. for $cos\,\phi = 1$ and curve 4 the full-load e.m.f. for $cos\,\phi = 0.8$; all three with the exciting

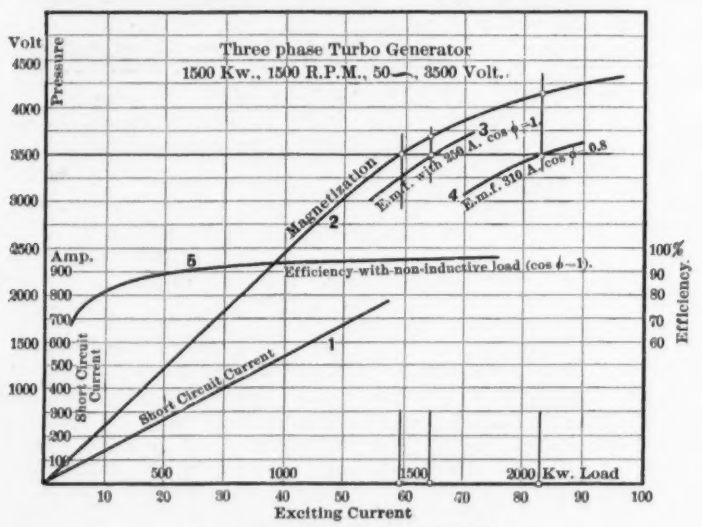


FIG. 5.—CHARACTERISTIC CURVES.

current as abscissæ. Curve 5 is the efficiency for various loads and $cos\,\phi = 1$.

To sum up once more the advantage of Brown's field construction, it may be stated that this arrangement renders it possible to build turbo-alternators with a high degree of *safety* even for speeds considerably in excess of those now used. The field is mechanically stiff and solid and, when once balanced, will always run true, and additional balancing later on is not necessary. The smooth cylindrical surface diminishes materially the losses by air friction, and guarantees noiseless running, a condition almost impossible to obtain with all types having projecting poles. The balancing is easily done by varying the material and size of the wedges driven into the slots. The ventilation of this subdivided field system is very thorough.

Brown first laid out this scheme in December, 1899, for an alternator of 3,000 hp, 800 r.p.m. directly-connected to a hydraulic turbine for an Italian carbide works, but the machine was not built by Brown. In February, 1901, the first turbo-alternator, according to this plan, was finished for the testing floor of Brown, Boveri & Cie. and in December, 1901, the first commercial turbo-dynamo, according to Fig. 3, was delivered for Upper Silesia (Tschöpeln).

The *direct-current types* entail even more difficulties than the three-phase alternator, as the rotating part with its induced winding, commutator and connection is decidedly more complicated, and the commutation problem is not easily solved for such high speeds. Even if the commutation is perfect, electrically considered, the mechanical difficulties with regard to a satisfactory brush holder have yet to be overcome. Brown made no attempt to employ the usual direct-current type in connection with steam turbines, but started directly with Deri's compensated field. After careful studies and overcoming finally all the different caprices of this whimsical type of machinery, Brown has undoubtedly made of it a commercial success. Fig. 6 shows the unwound laminated field, the larger holes being for

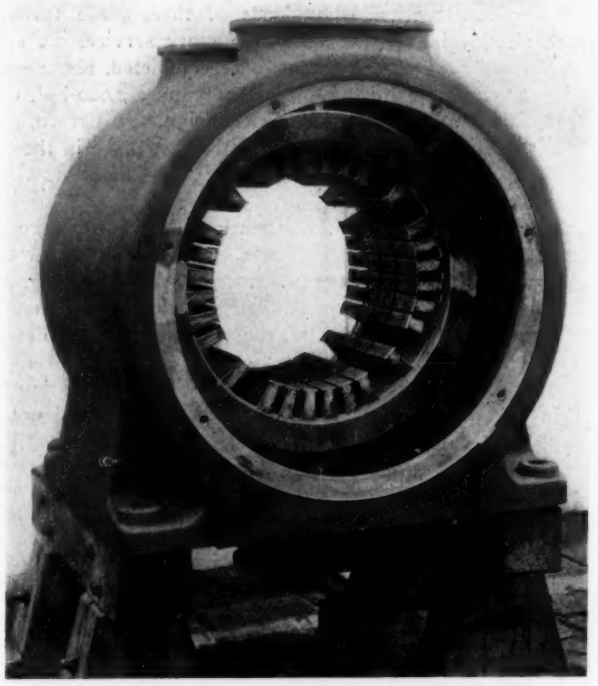


FIG. 6.—FIELD CORE OF DIRECT-CURRENT MACHINE.

the shunt winding, the smaller slots for the compensating series winding. The shunt winding is not spread, as originally stated in Deri's patent. The tooth between the two large slots is the commutating tooth which throws its field on the short-circuited field to neutralize the reactance voltage. The rest of the series winding acts only to compensate the armature ampere-turns. The effect of this arrangement may therefore be separated, according to Fig. 7,

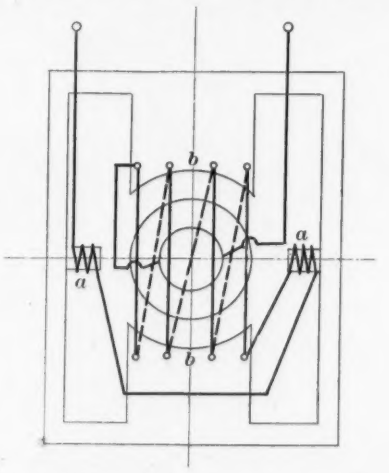


FIG. 7.—DIAGRAM OF AUXILIARY AND COMPENSATING FIELD WINDINGS.

into two components: (1) an auxiliary pole, *a*, (2) a compensating winding, *b*. In most cases the auxiliary pole, *a*, is entirely sufficient and *b* may be omitted.

The field provided with its two windings is reproduced in Fig. 8. I specially refer to the 2 x 2 bars near the commutating tooth. The end connections of the shunt coils are subdivided to increase the

[3]As not long ago an American writer reproached me with living yet in the mica age, I humbly state that besides an American practice in winding there is also a European one, both of which I thoroughly know. In Europe most concerns are successfully using seamless mica tubes for slot insulation, even for tensions up to 30,000 volts (Ganz & Co.) and also for high voltage railway motors.

ventilating possibilities. The exciting current for the shunt coils is derived *not* from the main voltage, but from a special *exciter*. This is merely one of the reasons for the successful operation of Brown's direct-current turbo-dynamos, as the tendency to hunting and jumping is decidedly decreased. The armature, Fig. 9, is of the

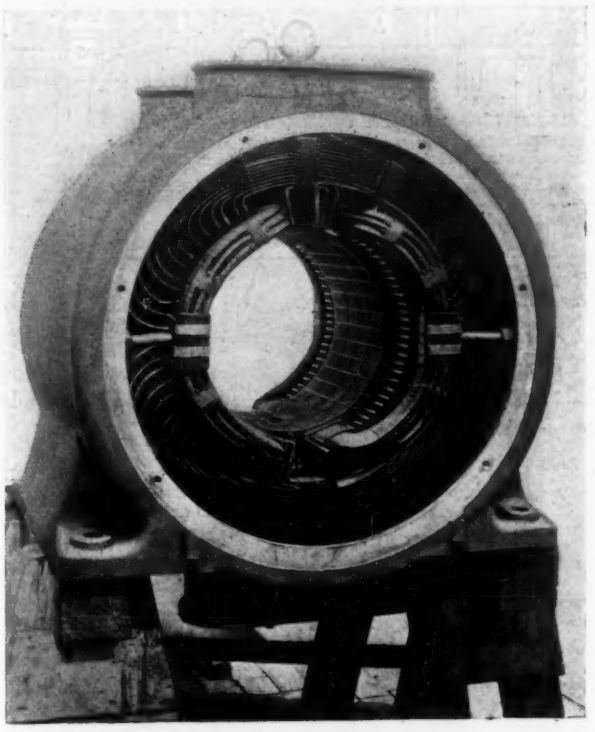


FIG. 8.—COMPLETED FIELD STRUCTURE, WITH WINDINGS IN PLACE.

usual drum type, with toothed core, ventilating ducts and strong wedges in the slots. The end connections are firmly secured to a bronze cylinder by a close covering of strong binding wires of about

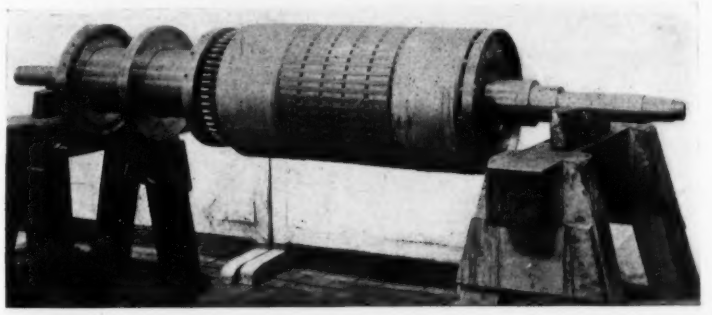


FIG. 9.—DIRECT-CURRENT ARMATURE FOR TURBO-GENERATORS.

2 mm. in diameter. The commutator is pressed together by three heavy shrinking rings. As previously mentioned, one of the hardest problems is the construction of the brush holders (Fig. 10). Brown uses metal brushes, usually thin brass sheets (brass leaf) for these high speeds. The brush holder is specially *elastic* in order to remain continuously in good contact with the commutator and not to be

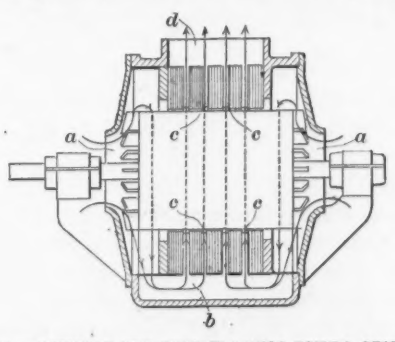


FIG. 11.—SCHEME FOR VENTILATING TURBO-GENERATORS.

thrown off. The brush pressure can be very steadily regulated by a fine screw. The brush holder studs are firmly fastened in two heavy cast-iron rings which avoid any vibration. Though theoretically the compensated direct-current type may have any reactance voltage one chooses, for securing a good commercial machine it is preferable to design the machine with as many commutator segments as possible, and with a reasonably large air-gap.

Before leaving Brown's designs it is well to introduce a descrip

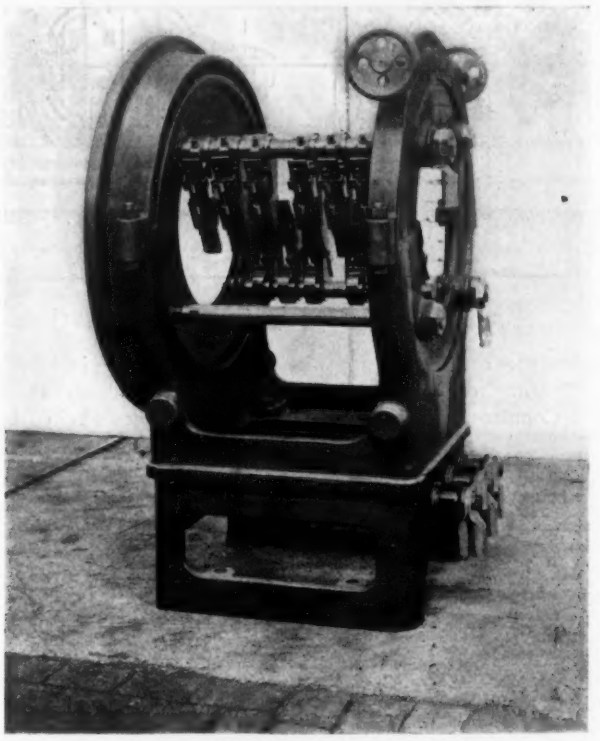


FIG. 10.—BRUSH-HOLDER FOR DIRECT-CURRENT TURBO-GENERATOR.

tion of an excellent scheme for ventilating turbo-generators which is used in all recent types, and which secures a noiseless service. The sketch, Fig. 11, is taken from the German patent No. 148,966. The air enters the machine at *a*, near the shaft, runs along the outer surface of the stator down to the space *b*, and then through the ducts, *c*, flowing round the whole rotor, leaving the frame by the opening, *d*. The Oerlikon Company (Zurich, Switzerland), which manufactures the Rateau steam turbine, uses the inductor type of

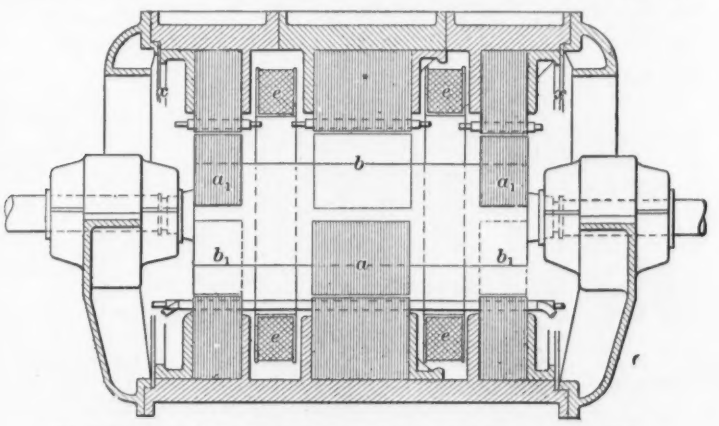


FIG. 12.—TWO-POLE FIELD STRUCTURE OF OERLIKON COMPANY.

turbo-alternators, which undoubtedly have the great advantage that all windings, the induced and exciting, are stationary, and there is rotating only a solid steel wheel, which may reach speeds up to 120 and 150 meters per second. The wheel has a double series of pole pieces equal in number to the pole pairs (half the number of poles). The rotating wheel is on all sides covered by a thin metal sheet, in order to form an absolutely smooth body to secure noiseless running. The balancing of the wheel is the easier the higher the number of poles; but, as already stated, turbo-generators usually have only 2 to 4 poles. For two poles the inductor type would have only one pole horn on each half of the wheel and would be entirely out of balance. The Oerlikon Company has, therefore, devised the very interesting arrangement, Fig. 12 (German patent 144,054). One pole horn is split into two parts, a_1, of half section, between which the other field pole horn, *a*, is placed, and shifted by 180°. The common exciting coil is also subdivided into two halves, *e*, and

frequently two other coils are added on both ends, *a e*, of the machine, to neutralize leakage fields through the shaft. Opposite to the pole horns, *a*, a_1, corresponding horns, *b*, b_1, of brass are fastened and auxiliary field. For electrical reasons and for securing noiseless service, it is advisable to incline the auxiliary poles somewhat to the axis of the machine.

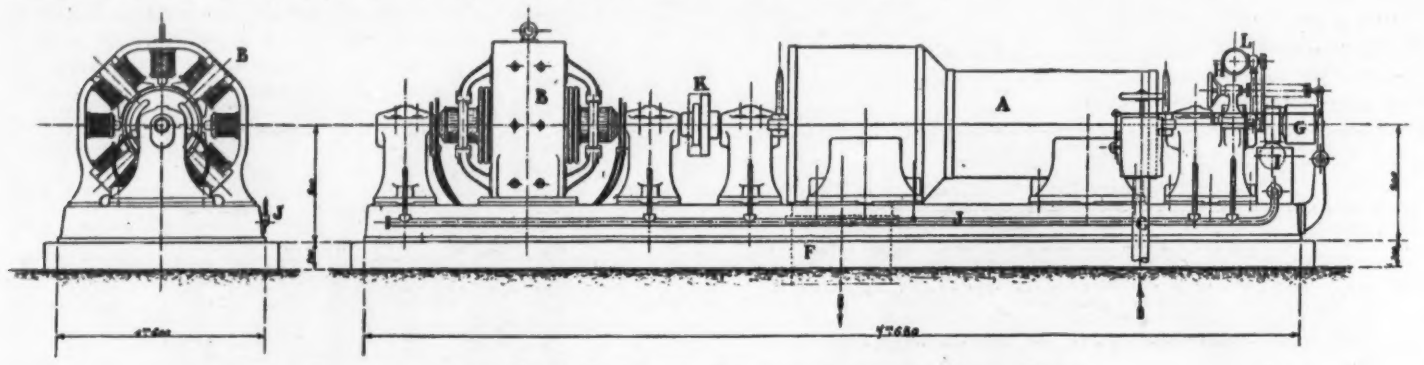


FIG. 13.—1,000-HP TURBO-GENERATOR, SHOWING AUXILIARY FIELD POLES.

to balance the rotating part. The induced winding is spread on three different iron cores. For direct-current turbo-dynamos the Oerlikon Company uses auxiliary commutating poles excited by the main current and put between the main poles. Besides the Union E. G. and Brown, Boveri & Cie., which work under the Deri patents, nearly all European concerns are using such auxiliary poles. Fig. 13 represents a turbo-dynamo for 1,000 hp and 2,200 r.p.m., built by Sautter, Harle & Co., Paris. This concern possesses also the patents for the Rateau steam turbine and has also chosen the inductor type for its turbo-alternators (Fig. 14), which have only one induced iron body, two exciting coils, one main air-gap and two auxiliary air-gaps near the shaft.

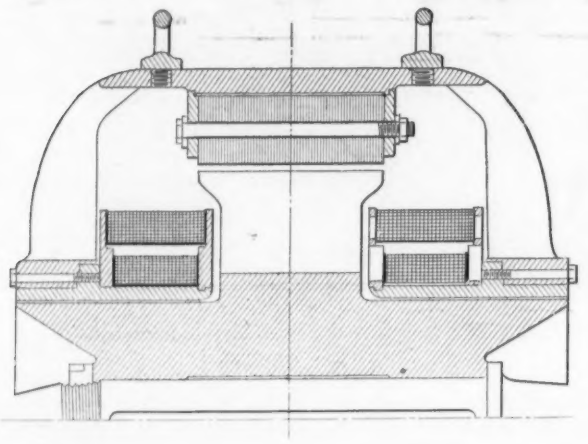


FIG. 14.—INDUCTOR ALTERNATOR OF SAUTTER, HARLE & CO.

The ampere-turns for auxiliary commutating pole of direct-current machines ought to be about 30 per cent. larger than the armature ampere-turns. The polar arc of the main poles of such types must be fairly reduced to about 50 per cent. of the pole pitch to avoid the interference between main

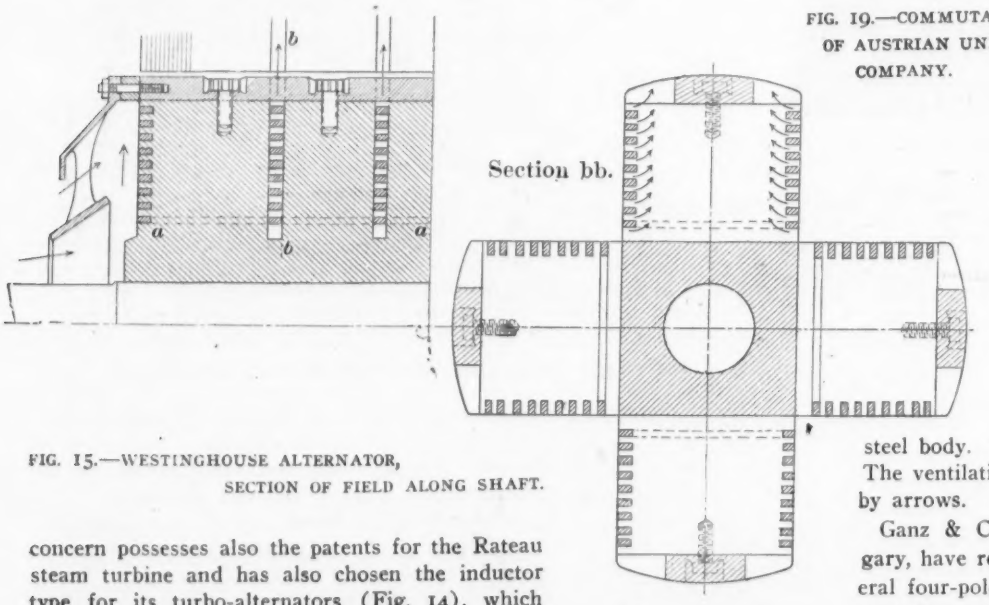


FIG. 15.—WESTINGHOUSE ALTERNATOR, SECTION OF FIELD ALONG SHAFT.

FIG. 16.—WESTINGHOUSE ALTERNATOR SECTION OF FIELD ACROSS SHAFT.

The rotating part of the Westinghouse alternators (Figs. 15, 16 and 17) resembles in some respects Brown's design. It is, however, provided with definite poles, and the subdivided field winding is

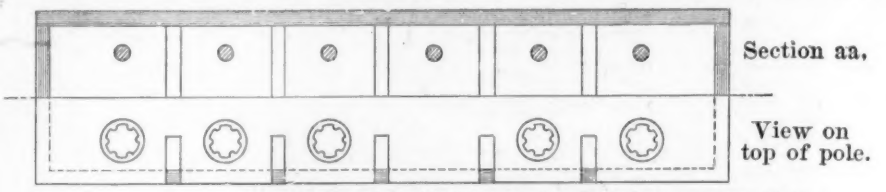


FIG. 17.—WESTINGHOUSE ALTERNATOR, VIEW OF FIELD POLE.

embedded into slots all round the poles, including the end connections. The slots and air ducts are all milled out of a solid cast-steel body. The pole shoes are fastened by heavy screws. The ventilation of the field coils and the stator is indicated by arrows.

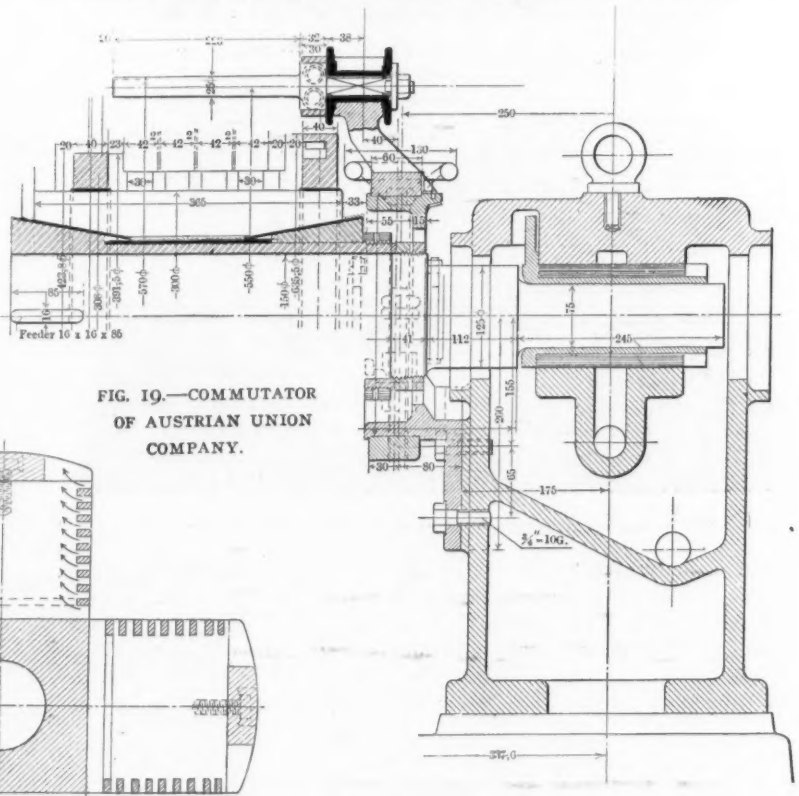


FIG. 19.—COMMUTATOR OF AUSTRIAN UNION COMPANY.

Ganz & Co., Buda-Pest, Hungary, have recently furnished several four-pole turbo-alternators of 1,000 kw, 1,250 r.p.m., direct-connected to Parsons turbines. They selected the rotating field type with definite poles and with a maximum circumferential speed of 20 to 80 meters per second. The field consists of the best cast steel. The poles leave an elliptical section and are built in one piece with the hub. The exciting winding is formed of copper strip on edge,

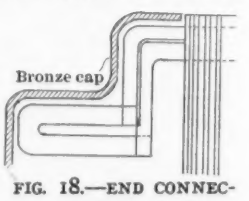


FIG. 18.—END CONNECTIONS OF AUSTRIAN UNION CO.

the centrifugal force of which has to be taken up by the solid cast-steel pole shoes. These are fastened to the poles by a double set of strong screws. The cylindrical surface of the finished field body is covered by a large number of strips of binding wire, leaving ventilating ducts between each other. At both sides brass sheets are screwed to the wheel and provided with ventilating wings, thus driving the air to the inside. The purpose of covering the whole surface on all sides is to avoid noise. The induced winding is imbedded into nearly closed slots and covered by seamless mica tubes. Ganz & Co. have, by-the-bye, accepted an order for an alternator which produces directly 30,000 volts in the machine itself. The slot insulation will probably be seamless mica tubes.

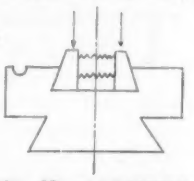


FIG. 20.—LAHMEYER DOVE-TAILED SLOTTED COMMUTATOR.

The Austrian Union Company, whose direct-current turbo-dynamo

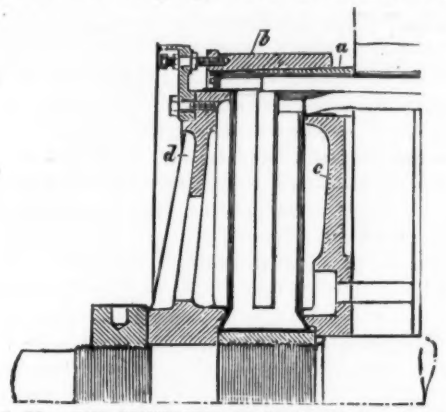


FIG. 21.—END CONNECTOR OF SIEMENS & HALSKE.

I described in my previous article, has changed slightly the method of fastening the end connections, as shown in Fig. 18. The bars coming out of the slots are bent radially toward the shaft, which con-

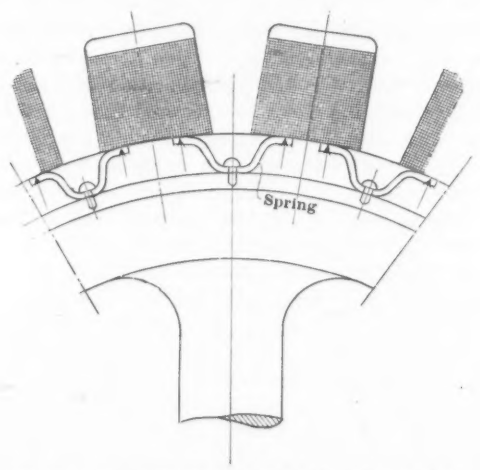


FIG. 22.—METHOD OF CONNECTING FIELD COILS.

struction permits of a smaller diameter of the end connections and therefore results in a material reduction of the centrifugal forces. Fig. 19 gives a fairly good idea of the commutator design of the Austrian Union Company as used for a 300-kw direct-current turbo-

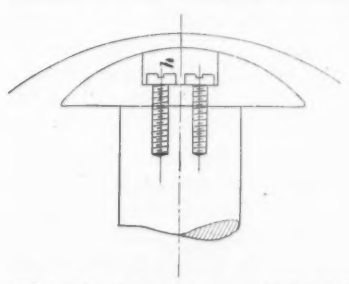


FIG. 23.—METHOD OF FASTENING LAMINATED POLE SHOES.

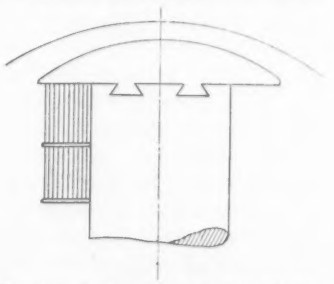


FIG. 24.—SCHEME FOR BUILDING UP FIELD.

generator (3,000 r.p.m.). It may be seen that the commutator, which rotates with a surface velocity of nearly 50 meters per second, is fastened by two shrinking rings. The journal box consists of three concentric brass cylinders, which do not rotate, and between which the oil is pressed.

Lahmeyer, of Frankfort, proposes in German patent No. 145,448 to mill dove-tailed slots into the commutators of high-speed dynamos (Fig. 20) to secure a safe contact between the brushes and the inclined surfaces of the commutator, a means which may render feasible the use of carbon brushes even for the highest speeds. Among the mechanical means for preventing the production of sparks on high-speed commutators may be mentioned the use of one by which

DIRECT-CURRENT, HIGH-SPEED DYNAMOS.

Manufacturers.	Austrian Union Co.	Brown, Boveri & Cie.	Brown, Boveri & Cie.	Oerlikon Co.	Rieker Winterthur.	Bregnet Double Laval Turbo.			
Output kw	330	180	100	350	700	200	10	250	900
Volts	650	450-650	220	600	600	250	110	500	470
R. P. M.	3000	3500	3500	1000	500	780	2800	3000	1000
Poles	2*	2	2	4	6	4	2	2	6
Type.	Deri compensated.	Deri compensated	Deri compensated.	Fig. ..	Double parallel winding.	Usual	Usual.	Deri.	Brush shifting.
Armature diameter .	520	400	350	700	1200	554	190	500	1100
Total armature length (iron)	360	350	350	300	Without any auxiliary poles and windings. Loop winding with 12 circuits.	420	100	350	230
Air-gap	5	7.5	...	10		7	...	...	12
Diam. of commutator	300	220	180	400		270	...	...	500
Useful length of commutator	240	470 (total)	350	280		310	...	...	260
No. of segments ...	108	100	...	240		120	...	...	150

Note.—All dimensions in millimeters.
*A more recent type has four poles.

THREE-PHASE, HIGH-SPEED ALTERNATORS.

Manufacturers.	General Elec. Co., N. Y.	General Elec. Co., N. Y.	Oerlikon Co.	Schuckert.	Union E. G.	Parsons.	Oerlikon Co.	Union E. G.	General Elec. Co., N. Y.
Output kw	5000	7500*	3750	1000	1400	350	1200	2600	1500
Periodicity	25	25	50	50	50	100	50	42	50
R. P. M.	500	250	300	1500	500	3000	1500	315	1000
Outside diameter of rotor	2200	3800	2480	1050	1600	430	860	2700	1170
Axial length of rotor	1200	1300	750	500	700	1280	850	660	550
Construction of rotating part.....	Rotating field, definite poles fixed to the hub by a series of wedges. Copper strip on edge. (See E. W. & Eng., March 26, '04. Fig. 6.)	Rotating field, definite poles screwed to the steel wheel. Copper strip on edge. (Canadian Niagara power plant.)	Rotating field. Poles screwed to the steel wheel. Copper strip on edge.	Rotating field, definite poles. Copper strip on edge. 25 volts for excitation. (Elec. World and Eng., March 26, 1904, Fig. 16.)	Rotating field, definite poles, dove-tailed into steel wheel. Wooden wedges between adjacent coils. (E. W. & E., M'ch 26, '09, Fig. 13.)	Rotating armature poles outside.	Rotating field, ring winding. (See Electrical World and Engineer, March 26, 1904, Fig. 10.)	Rotating poles dove-tailed to the steel wheel and held by steel wedges. Copper strip on edge. Air-gap = 13 M.M.	Rotating poles fastened by screws to the steel wheel, copper strips on edge.

Note.—All dimensions in millimeters.
*The Siemens-Schuckert works are just now erecting three-phase generators for 8000 horse-power, designed to run at 300 r.p.m.

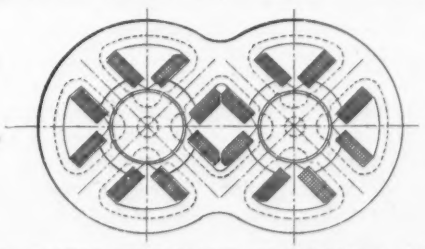


FIG. 25.—DOUBLE FIELD-FRAME OF SIEMENS & HALSKE.

the brushes may run, if they are applied to the inside of the hollow commutator (Osnos).

To Siemens & Halske has been granted the German patent No. 149,242 treating of auxiliary commutating poles, which are not directly fastened to the main yoke, as in Fig. 12, but the commutating poles have their own yoke, which means that they possess an entire magnetic circuit of their own, which is not influenced by the saturation of the main magnetic circuit. A noticeable way of fastening the end connections, on which a patent (German patent 127,214) was granted to Siemens & Halske, may easily be recognized from Fig. 21. The conical segments, *a*, are pressed down on the winding by full conical rings, *b*.

When using copper strips on edge for high speeds, the copper turns must be carefully wound, the surface of the copper must be absolutely smooth and, to avoid movements of the coils when running at various speeds, the coil ought, before erecting, to be firmly compressed by screws or springs, as shown in Fig. 22 (German patent 148,766). In the case of laminated pole shoes screwed to the poles one has to put the nuts of the screws quite deep below the pole shoe surface (Fig. 23) 20 to 30 mm. to avoid excessive eddy currents, if the slots of the induced part are open and the air-gap is small. A scheme of building up the field of turbo-alternators not mentioned previously is sketched in Fig. 24. The copper is not on edge, but flat. There is, however, the danger that the copper is knocked together by centrifugal forces.

It is a well-known fact that the design of Laval turbo-generators is causing little trouble, as the speed is reduced by gearing. A 100-hp unit is running with about 1,050 r.p.m., a 300-hp set with 750 r.p.m. These larger sets usually consist of two dynamos, and in this case one may find it very advantageous to use the field frame of Siemens & Halske (Fig. 25, German patent No. 143,121). In comparison with two entirely separate frames, one saves a considerable yoke iron.

In conclusion, I have added above a table giving the main dimensions of high-speed dynamo, including also generators connected to high-speed turbines and of motor-generators with heavy fly-wheels[4], as recently used in European rolling mills and for large winding machines.

Naval Wireless Telegraphy.

Admiral Manney, chief of the Bureau of Equipment of the Navy Department, in a recent report to the Secretary of the Navy, shows that the bureau has already established 22 wireless telegraph stations along the coast. It contains a list of 60 additional points where the wireless system is to be installed. These latter include not only the North American Continent, but all the insular possessions of the United States. The Isthmus of Panama is included. The bureau's idea is to equip the more important of these stations in the near future, and the remainder as the necessities of the navy and the merchant marine make it desirable, having due regard to expense. The stations already established are Cape Elizabeth, Portsmouth, Cape Ann, Boston, Cape Cod, Newport, Montauk Point, New York, Navesink, Cape Henry, Norfolk, Annapolis, Washington, Key West, Dry Tortugas, Pensacola, San Juan, Culebra, Yerba Buena Island, Mare Island, Cabras Island and Cavité. The stations to be established are Frenchman's Bay, Sankaty Head, Nantucket, Nantucket Shoal Lightship, Absecom Light, Cape Henlopen or Delaware Breakwater, Assateague Island, between Currituck Beach Light and Bodie Island Light; Cape Lookout, Cape Fear, Cape Remain, Charleston, Savannah River, Cape Canaveral, Cape Florida, Alligator Reef, Boca Grande, Tampa, Cedar Keys, Cape San Blas, Mobile Bay, mouth of the Mississippi River, New Orleans, Raccoon Point, Sabine Passage, Galveston, mouth of the Rio Grande River, Bahia Honda, Cuba; Guantanamo, Cuba; west end of Porto Rico, Panama Canal, east end of Panama Canal, west end of San Diego, San Pedro, Point Concepcion, Point Sur, Point Arena, Cape Mendocino, Cape Blanco, Columbia River, Cape Flattery, Point Townsend, Bremerton, Wash.; Sitka, Dutch Harbor, Kiska Island, Honolulu, Midway Island, Guam; Tutuila, Cape Bojeador, Point Piedras, Capones, Olongapo, San Bernardino, Point Suban, Point Cebu, Point Tabuna, Iloilo, Suriabo Straits and Basilan Straits.

[4]A motor-generator set, consisting of an induction motor (600-hp, 375 r.p.m.) and a direct-current generator (500-kw, 365 r.p.m.) with a fly-wheel of 20 tons between them, was built by the Union Company, Berlin. The motor has two self-lubricating bearings, the dynamo one outside bearing and the fly-wheel has two special bearings lubricated by oil under pressure from below and cooled by circulating water. The specific pressure on the bearing is 12 kilograms per square centimeter (projection) and the circumferential speed of the rim 4-3 meters per second.

Interior Wiring for Telephones.

By Charles H. Coar.

THE selection of the wire and accessories and the method to be used in their installation for interior telephone service is dependent largely on the nature and condition of the surroundings, and consequently no certain method or material is likely to be applicable in all cases. The material involved and the conditions it would have to withstand should be taken into consideration when determining what method is most efficient, and, therefore, it is essential to exercise some judgment when any variation from the usual procedure becomes necessary.

Some companies specify that a protector, or lightning arrester, shall be installed with the telephone on all circuits which terminate aerially at the subscriber's end, while other companies modify this rule by making exempt those circuits which run with insulated wire from distribution poles directly to the subscriber's premises.

It is generally conceded that an aerial circuit should be protected at the subscriber's premises against excessive currents and lightning, but a diversified opinion exists as to the practicability of protecting insulated circuits that come from distribution poles, principally because of the reasons mentioned below. Time has fully proved that very few cases of burn-outs either from lightning or excessive currents occur on distribution pole circuits of this description, when there is installed at the pole itself proper fuse protection in connection with the usual heat coil and carbon arrangement at the main distribution rack.

The comparative short distance such lines are open to the elements and their high insulation resistance, insulated wire being used for this purpose, combine to reduce the chances of burn-outs to such an extent that the installation of these protectors would necessitate a needless expenditure for additional apparatus at the subscriber's station.

The proper place for a telephone protector is on the outside of the building at the interconnection of the interior and line wires. It is, however, not usual to install them at this place, because it becomes necessary to protect the arrester from the weather. In general, it is considered best to place the protector inside the building as near as possible to the point where the outside wires enter, and also to connect the protector, if it has a combination of fuses and carbons, in such manner that the fuses are inserted between the outside and inside conductors, with the carbon ends nearest the telephone. When the fuses operate in protectors thus connected, the outside circuit is completely opened at this point, and, consequently, there exists at this point no attraction for outside foreign currents. The earth connection for the protector should be made outside the building, although it is permissible to use a grounded water pipe for this purpose, if the pipe goes to earth in close proximity to the protector, so that no great length of interior protector ground wire becomes necessary. A protector offers but little protection to a subscriber's premises, if all the excessive charges it wards off have to seek earth by means of a circuit which leads these charges throughout the premises, because frequently in such installations a charge will dissipate itself otherwise than through this circuit, thereby making possible serious damage. It is not advisable to install any protector ground wire smaller than 16 B. & S., heavy insulated copper, and this should be fastened by porcelain cleats, knobs and tubes in such manner that it will be held firmly away from the walls, etc. Wires should enter a building through separate insulator tubes inserted on an upward angle of at least 20° to prevent moisture entering through them. When installing an arrester one should endeavor so to place it that it will be readily accessible for inspection and repairs.

In making ground connections it is essential that the ground wire be firmly fastened to the earth connection. It is very difficult to solder a wire directly to a water pipe, but by using a bond or strap of galvanized tin a good connection may be obtained. A strip 1 in. in width by 10 in. long is of a convenient size and in this a hole may be punched with a nail at a point required to fit the strap tightly around the object used for the earth connection.

In case of a new installation one should investigate the possible routes of placing the wire, and then choose that route which seems most efficient when all facts involved are taken into consideration. In stores and residences when possible the wire should be installed in the basement in preference to running it on shelves or moulding, because it is more accessible to repairmen and less liable to interference. Unless it becomes absolutely necessary, wires should never be strung through window sash or over doors which may at any time

be opened, thus breaking the wire. When boring holes through walls, etc., a little thought as to the construction of the building will frequently save many tedious hours of work. It is permissible, if insulated saddled staples are used, to place the staple over two wires, but this should not be done with bare staples or when poorly insulated wire is being used, and in places where the wire will be exposed to dampness it is best to support it by some insulating fixture, such as cleats, knobs or tubes. In crossing obstructions such as water pipes, gas pipes, light and power circuits, the telephone circuit should be placed above them in suitable tubes. In buildings having lath and plaster construction, there are many opportunities for concealing the wiring, and when the work is to be permanent this should be done, proper precautions being taken as to the insulation.

Concealed wiring can be placed in buildings of this description without much difficulty by using a small chain and cord. About two feet of small chain, which is comparatively strong and heavy, can be fastened to a cord and caused to fall between the walls, where it can be fished out at any point desired. After inserting the wire in an insulating tube provided for the hole at the moulding, it is fastened to the string and pulled to place. Knowledge of the construction of the building enables one to bore holes in the right position and to place the wire from floor to floor, either up or down, in this manner much more quickly than by any other method, and the result is a much more presentable and permanent installation.

Where wires pass into or out of inner walls, tubes should be used, but it is not necessary to use a separate tube for each wire, if the wire is properly insulated, and no detrimental conditions, such as dampness, exist at these points.

In buildings containing some method of distributing the lines from a common point, it is usual to install a cable of sufficient capacity from the exchange directly to this point. For this method there is required a distribution box which has suitable clips to terminate the house cables or wires in cross-section with the terminal clips of the exchange cables. The box should be constructed of kiln-dried lumber of sufficient size to accommodate the different cable forms and strips and thoroughly painted inside and out. The doors should be arranged to fasten with key and lock in a manner such as to exclude the dust as much as possible. All clips in the different strip terminals should be numbered.

The method adopted in distributing the different lines from the house terminal strips would depend solely on the local conditions, for in some cases it is preferable to run separate cables from the main house terminal strips to a similar strip located at each floor, while in other cases it is best to run one or two house cables so arranged that the different floor terminal strips are in multiple with each other. The first method is preferable in buildings in which the different floor terminal strips are not in the same relative position on each floor, and only one party line service exists, for in such buildings it is possible to connect any of the house lines together at the main distribution box. If subscribers on different floors are to be connected to one circuit, it is best to arrange some method of paralleling the different terminal strips with each other, either completely or partially, because it is then possible to connect the lines together at the floor terminal strips. In case a circuit is out of order, it is difficult to repair when this method is used, because the different multiples on each floor must be opened in order to ascertain on which floor the trouble exists, while in the other method each individual circuit can be tested from the main distribution box or at the floor terminal strips if necessary.

Plans or specifications for the wiring or conduit work for telephones in large office buildings, usually become part of the construction contracts in much the way as with the electric light system. It is customary to arrange the different terminal strips and distribution boxes in close proximity to the different floor fuse panels of the lighting system, one runway or shaft being used to convey the cables of both systems.

The room wires in such buildings are often enclosed in conduit pipes arranged with outlets and terminals at the moulding and baseboard of each room, to facilitate placing the telephone in any position without having to run wire up or down the walls. It is advantageous to install the interior wire or make provision for its installation during the course of construction of all large office buildings, as this work can be done most economically during this time.

Rewiring or installing an interior system, as is herein outlined, in completed or occupied buildings is a difficult task, because of the many obstacles to be overcome. An elevator shaft can frequently be utilized to convey the house cables from the main distributing box to the floor terminal strips in completed buildings, if no other route is available, but extra caution should be exercised to protect the cables from any injury due to moving elevator apparatus, such as chains, counter-weights, etc. It is advisable in some instances where cables are installed in shafts, to place the cables in iron pipes for protection. After the different house cables are installed in connection with the floor terminal strips, the wires are run to the office rooms, preferably in specially prepared moulding placed on the walls throughout the halls of buildings near the ceiling. The floor terminal strips should be placed in a box suitable for protection against dust and interference from other sources.

It is not always possible to use screws to secure objects to the walls of fire-proof buildings, unless the screws are placed in wooden plugs previously driven into holes drilled into the walls, as the walls of these buildings are usually composed of hollow tiling. To overcome this difficulty, toggle bolts may be employed, as they may be inserted in holes drilled into the interior space of the tiling, where the toggle bolt limbs have sufficient room to spread out, thus securing themselves against being pulled directly out.

Although it is impossible to form a set of rules or methods of procedure which will be efficient and applicable in all the varied conditions under which interior wiring is done, the few specifications and rules given below are applicable in many instances.

(*a*) The wires should enter the building through separate insulating tubes inserted at an angle sufficient to keep the moisture from entering them.

(*b*) Where a protector is installed, the leading-in wires should be placed on separate insulators up to their respective protector terminals.

(*c*) The protector should be located as near as possible to the point where the outside wires enter the building. It should be accessible for repairmen.

(*d*) The protector should not be placed among inflammable material, such as lace curtains, etc.

(*e*) The protector should be so connected that in case its fuses rupture the circuit will be completely opened at this point.

(*f*) The protector ground wire should be thoroughly insulated from all walls and fixtures.

(*g*) The protector should be connected to earth by the most direct route.

(*h*) It is permissible to utilize water pipes for earth connections if the connection is made near the point where the pipe enters the earth.

(*i*) Gas pipes in buildings should never be used for earth connections.

(*j*) The protector ground wire should not be smaller than 16 B. & S. heavy insulated copper.

(*k*) If an earth connection is made inside the point where the meter is installed, a jump should be connected around the meter to insure an earth connection in case the meter is removed.

(*l*) All connections should be soldered.

(*m*) All connections in the wires should be so made that no two will come directly opposite each other, and the connections should be thoroughly taped.

(*n*) Insulating tubes should be used to convey the wires through interior walls.

(*o*) The wires should be placed above such obstructions as gas and water pipes or electric circuits and properly insulated.

(*p*) The wires and accessories should be placed out of sight as much as possible.

(*q*) The wires and accessories should not be fastened to objects likely to be moved.

Mr. Gould in the Telephone Field.

It is rumored in the West that Mr. George Gould is about to enter the independent telephone field. It is stated that some months ago an offer was made for the purchase of the United States long-distance property, and it is supposed that this offer may have come from the Gould interests, although at the time it was though to be backed by the Bell Co. The officials of the Federal Telephone Company, of Cleveland, are reported to have said that no overtures have been made to that company looking to the purchase of its property. This is an old rumor in slightly altered form, and shifted from the East to the West.

Wireless Telegraph Aerial Wires and Earths.*

BY A. FREDERICK COLLINS.

HISTORICAL.

IN a patent granted to Thomas A. Edison, dated December 29, 1901, means are shown for transmitting signals without wires by elevating plates of metal on poles or by balloons. The aerial wire was connected to one terminal of a secondary coil with the opposite terminal leading to the earth; while this is perhaps the earliest reference to aerial wires and earth plates, the method does not employ either a spark-gap or a wave detector for oscillatory currents. In Amos E. Dolbear's patent, issued in 1886, no reference is made to the elevation of the capacities he suggested for the equalization of the coefficients of the circuit connected with the earth. In 1895 Isadore Kitsee obtained a patent for signaling without wires and indicated how one terminal of the system was extended vertically to an elevation approximating the height of a vessel's mast. The antenna and earth utilized by Prof. Popoff in his meterological receptor in 1895 and that by Signor Marconi in his electric wave transmitter, the patent application of which was filed in England in 1896, are the earliest references to the subject of aerial wires and grounds in connection with electric wave wireless telegraphy. In Nikola Tesla's British specification, filed October 21, 1897, he describes a method of producing "a very high electrical pressure, conducting the current thereby to earth and to a terminal at an elevation." The various designs for aerial radiators and antennæ employed in different systems will be treated in sequence in the text appertaining to their application in practice.

THEORETICAL.

There are two theories relating to the probable capacity of the earth and several concerning the rôle the earth plays in the operation and propagation of electric wave signals. The true solution of the problems presented by the earth might prove the key to syntonic wireless telegraphy. In one of the two theories referred to the earth is considered as a sphere insulated in space; the second and opposition theory assumes the earth with its surrounding envelope of air to be a condenser. Koepsel[1] by a formula in electrostatics for the potential of a charged sphere insulated in space deduced a result showing the earth's capacity to have a low value and comparable with artificial capacities used in wireless telegraph practice.

The second theory treats the earth and air as if they were two concentric spherical shells, the medium between them representing its specific inductive capacity, when their capacity will be the same as in the case of two parallel plates with their surfaces brought in close proximity with each other in the form of a condenser. If, as the first theory postulates, the earth is a single spherical shell insulated in space, its capacity must necessarily be very limited, since a single coating on a glass jar would be incapable of acquiring more than the slightest charge; but if the stratum of atmosphere holds a charge opposite to that of the earth, then it may be likened to a complete Leyden jar with its inner and outer coatings, and its capacity would be enormously increased. The importance of knowing absolutely the capacity of the earth cannot be overestimated, but could such conclusions be thus positively ascertained, the density of the charge at a given point could only be taken as a theoretical standard; for, owing to the differences of atmospheric densities, the electric charge may be maximum or minimum at any point at any given instant, and even then of a different sign.

Many different views have been submitted to explain the relation of the earth to the radiating and receiving systems; among the most prominent may be mentioned the following: (*a*) that high-frequency currents are projected from the earthed terminal of the oscillator, whence they are conducted by the earth to the resonator; (*b*) that the earth acts simply as a local capacity for the aerial wires; and (*c*) that the earth, having a large value, serves to tune the oscillator and resonator, since both being grounded would represent the same capacity. As to the nature of the earth as a conducting medium for electric waves there is also a variance of opinion; by those advocating sliding waves the sea is regarded as opaque to electric waves, and it is claimed that in this it fulfills Maxwell's law in that salt water is a conductor of electricity. Others voice the opinion that the sea will transmit electric waves, since salt water does not follow the general law for conductors, in that it conducts by electrolytic action. One fact, however, is positively known, namely, that electric waves are much more easily transmitted over salt water than over fresh water or land. Whatever these conditions may be, it is well known that if a metallic conductor, as a lightning rod, be extended upward in the air and its lower terminal connected with the earth, a constant current will flow through it, equalizing in a small measure a difference of potential that is always present. If this conductor is divided and the resulting terminals form an air-gap, the potential difference may be measured by a galvanometer, or if the air-gap is microscopic in size sparks will pass; if a detector of the coherer type is inserted in the gap the filings will cohere under certain meterological conditions and the restoration of the charge will be indicated. In practice these atmospheric disturbances often produce characters on the tape of the recording instrument, and these untoward indications are called "X's," or strays. The purpose of the aerial wire, on the one hand, is to send out transverse vibrations in the ether in the form of electric waves, and on the other, to receive them; it was ascertained by Dr. Slaby and Prof. Braun that the proper length of the aerial wires should be one-fourth the length of the emitted wave, and therefore the radiator and antenna should have as nearly the same height as possible.

A law relating to the distance over which electric waves may be transmitted with a given height of aerial wire was deduced empirically by Marconi very early in the practice of the art. This law states that with a given current, instruments of standard dimensions and all other factors being equal, the distance to which signals may be transmitted increases as the square of the length of the radiating wire; or, graphically, if a wire 20 feet in height will transmit one mile, a wire 40 feet in height will send waves four

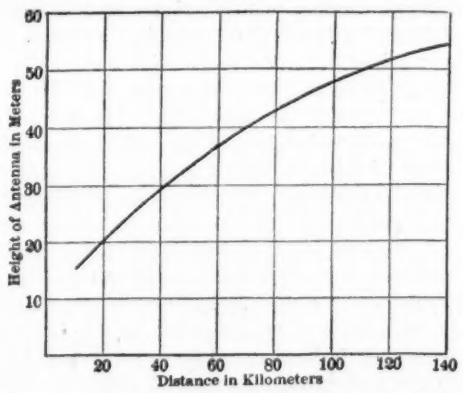


FIG. I.—CURVE OF TRANSMISSION DISTANCES.

miles, and one 80 feet in height will transmit waves sixteen miles, *et cetera*. This general law was mathematically evolved by Prof. Ascoli, who deduced his conclusions in accordance with Neumann's formula and found the reciprocal action to be proportional to the square of the length of one of the two aerial wires if these are of equal length, and in simple inverse proportion of the distance between them.

It would seem that the empirical law of Marconi and the deductions of Ascoli are subject to modification for Captain Bonomo, of the Royal Italian Navy has determined that the distance to which signals may be transmitted is in accordance with the formula $L = O.15 \sqrt{D}$ where L represents the length of the aerial wire, D the signaling distance in meters and $O.15$ is a constant. Where a number of parallel wires are employed instead of the single vertical wire as first used by Marconi this apparent discrepancy is accounted for, not only because of the greater radiation of energy, but also in virtue of a longer wave length emitted.

The intensity of the oscillations does not diminish with the increase of distance if the length of the aerial wires is increased in proportion or as the square of the distance; therefore, by doubling the height of the aerial wires the distance of signaling may be four times as great. In a series of experiments carried out by Dr. Slaby to determine with precision the exact height of aerial wire required to transmit messages over a given distance the curve shown in Fig. 1 was plotted. Starting with an initial energy of 746 watts, the curve represents the maximum distance for transmission over bodies of salt water, with the Slaby-Arco standard station apparatus. Considerable latitude has been allowed for meterological, climatic changes and unfavorable conditions of the year, as, for instance, the heated atmosphere of the summer months. The accuracy of the

*From advance sheets of "Wireless Telegraphy; Its History, Theory and Practice" in press.

[1]Koepsel, Dingler's Polytechnisches Journal, June, 1903.

curve has been tested carefully, and while the sending and receiving instruments are calibrated in accordance with the curve, their actual working distance may be much greater, as, for instance, it was found possible to obtain messages between the *Deutschland* and the *Duhmen,* a distance of 150 kilometers, whereas the curve gives the working distance as 80 kilometers. The photo-electric effect of sunlight on aerial wires was deduced by Marconi[1] upon the conclusions reached by Hertz[2] in 1887, who found that the effect of one electric spark from an induction coil on another had a tendency to diminish the size of the latter, and that this curious result was due to the ultra-violet radiation—in which the disruptive discharge is rich—dissipating the charge of electricity stored in the second oscillatory system. Righi[3] attributed the cause to the ultra-violet radiation producing correction or the process of dispersing negative electricity, the charge being carried away by the molecules of air. Righi also determined that ultra-violet radiation charged wires, when insulated, with positive electricity, and Elster and Geitel have been able to show the dissipating influence of not only sunlight, but of diffused daylight on conductors. This phenomenon was observed at the antennæ by Marconi when he received signals a distance of 2,099 miles from Poldhu, Cornwall, England, on the steamship *Philadelphia.* During the tests made on this trip it was ascertained on one occasion that the signals were distinct and clear at night for 2,000 miles, but in daylight the signaling distance was only a fourth part as great, or 500 miles.

PRACTICAL.

In practice it is of vital importance to maintain absolute insulation of the aerial wires and earthed terminals of the radiator and resonator, for in utilizing high-frequency, high-potential currents leakage becomes excessive should any portions of the systems come in contact with masts, buildings or other physical appurtances. Where the aerial and ground wires are sustained or supported heavy glass or porcelain insulators are desirable. The wires themselves should be highly insulated, since this protects the oscillatory currents from dissipating their energy in the atmosphere and does not retard the action of the electric waves, for insulators are transparent to them.

METHOD OF SUSPENSION.—A simple and efficient method for suspending aerial wires from the yardarm of a mast is shown in Fig. 2; the mast is represented at 1, the yardarm 2, insulator 3, capacity area 4, and wire 5. The insulator is supported by a loop of tarred rope attached to the yardarm, and the capacity area, or wire if it be used direct, is inserted longitudinally in the insulator as as shown. The method illustrated in Fig. 3 was designed by Ducretet and is a superior modification of the one just described.

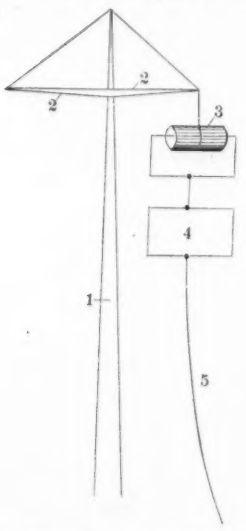


FIG. 2.—METHOD OF SUSPENSION.

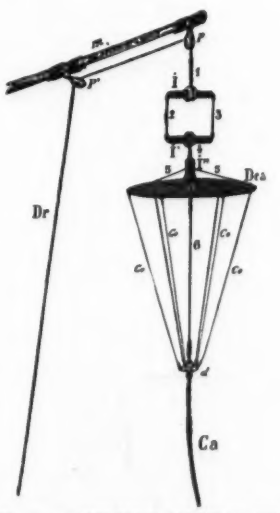


FIG. 3.—DUCRETET METHOD OF SUSPENSION.

A method to eliminate leakage where the aerial wire leads into the station to the instruments is shown in Fig. 4 and is due to Dr. Braun; it will be seen that the leading-in wire passes through a porcelain bushing inserted in an aperture cut in the window-pane.

FORMS OF ORDINARY AERIALS.—The early Popoff antenna consisted

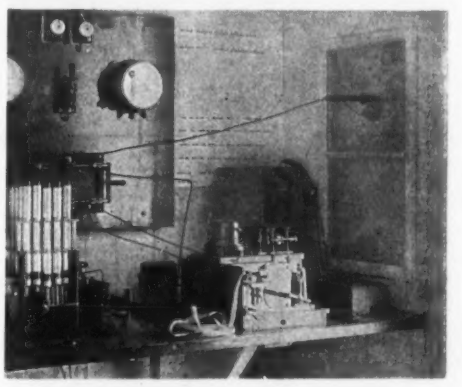


FIG. 4.—BRAUN LEADING-IN METHOD.

of a lightning-rod, while that employed by Marconi in his first essays comprised a single copper wire leading from the instruments and

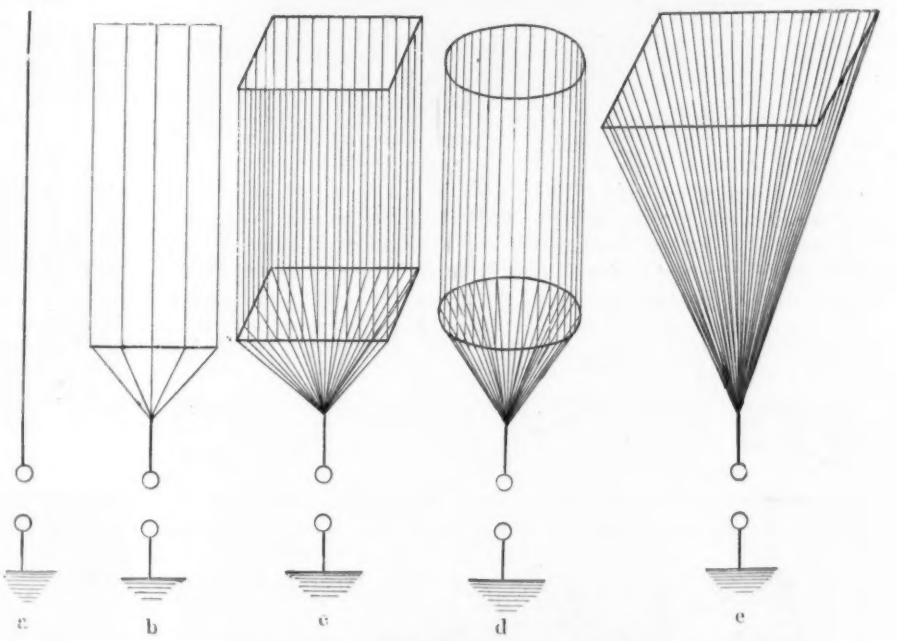


FIG. 5.—VARIOUS FORMS OF AERIAL WIRES.

to which a large metal plate was attached to its upper free terminal. Various forms of aerial wires are shown in Fig. 5; the object of adding to the number of wires is to obtain a greater radiating and receptive surface. Referring to the figures, *a* is the ordinary single wire aerial, *b* parallel wires which are in some cases arranged in fan shape, *c* multiple quadrangular aerial, *d* multiple

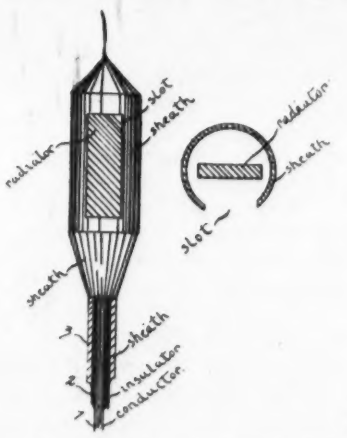


FIG. 6.—GUARINI SHEATHED AERIAL.

cylindrical aerial, and *e* inverted pyramidal aerial form for long-distance transmission. The length of aerials is from 50 to 200 feet. Fleming has pointed out that if an aerial is composed of seven strands of wire, each having a diameter of No. 22 B. S. G., and a

[1]Royal Society; Discourse by Marconi, June 12, 1902.
[2]Wiedemann's Annalen 31, p. 983.
[3]Comptes Rendus, vol. 107, p. 559.

length of 150 feet, and insulated from the earth. Its capacity, if held vertically, is 0.0003 microfarads. If a number of wires are placed very closely together, their combined capacity is not merely equal

FIG. 7.—DIFFERENTIAL AERIAL SYSTEM OF JEGON.

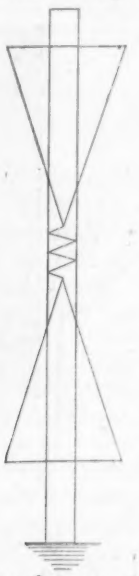


FIG. 8.—LODGE CAPACITY AERIAL

to the sum of their individual capacities[4], and therefore the wires should be placed at a considerable distance apart.

LODGE CAPACITY AERIAL.—The earliest form of aerial, if such it may be termed, for the purpose of selective signaling, is due to Lodge; it is shown in diagram Fig. 8. Two cones of large dimensions, made of metal and insulated from themselves and the earth, served to increase the capacity of the system as well as to indicate and receive the electric wires. The capacity areas were of a definite value, but were connected with an inductance coil so that this factor could be changed.

TOMMASSI JEGON DIFFERENTIAL WIRE AERIAL.—The differential aerial system introduced by Tommassi Jegon some years ago was intended to receive various wave lengths simultaneously by employ-

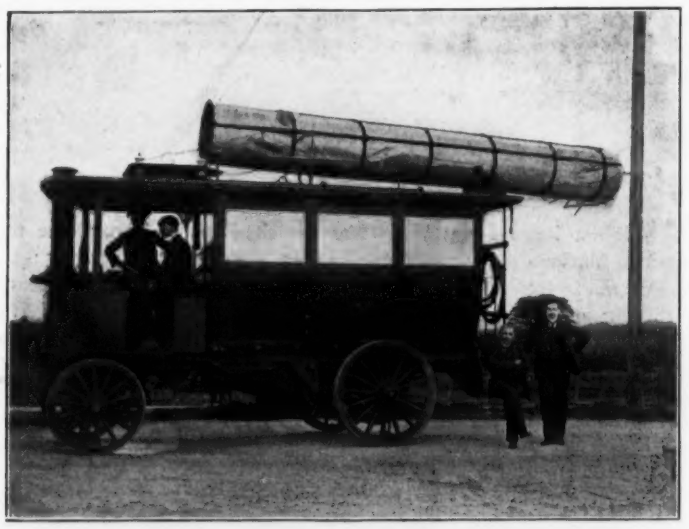


FIG. 9.—MARCONI WIRELESS TELEGRAPH AUTOMOBILE.

ing two or more wires at the transmitting station, as at *A*, Fig. 7; these radiating wires were of different lengths at the receiving station, *B*; 5 km. distant the antenna was equal in length to the shorter one at *A*, while at station *C*, 10 km. distant, the antenna was equal to the longest wire at *A*. By a proper adjustment the indications will not respond except when the shortest wire at *A* is sending to *B* or the longest one at *A* to *C*, except where a definite value of the distance produces a neutral effect on both receivers.

GUARINI SHEATHED AERIAL.—The fact that electric waves are intercepted, reflected and absorbed by metals led Guarini to devise the sheathed aerial shown in Fig. 6; the aerial wires emitting and receiving the waves were insulated and then encased in a metallic sheath diverging at the top, forming a cylinder of large diameter in which a slot was cut; the purpose of this arrangement was to reflect the emitted waves in a given direction or to receive them from a

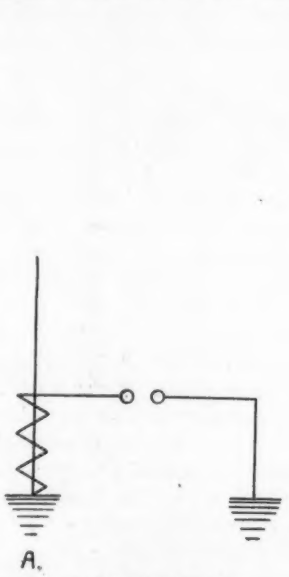


FIG. 10.—SLABY-ARCO DIRECT-EARTHED AERIAL.

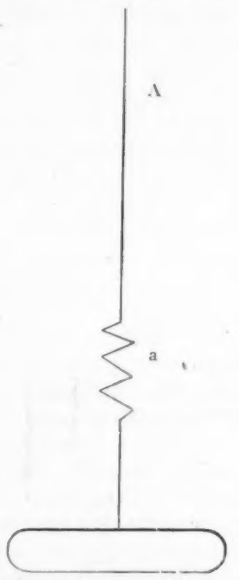
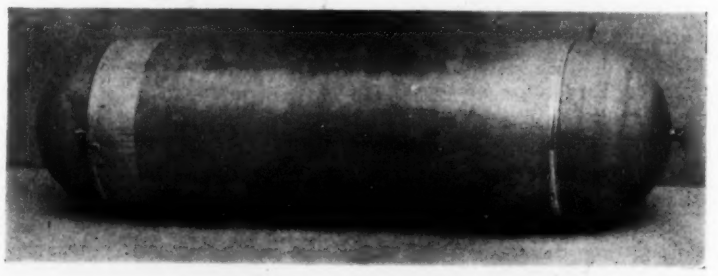


FIG. 11.—BRAUN ARTIFICIAL EARTH.

given point of the compass. There is a very great loss of energy in this method of transmission, but in specific cases it might be useful.



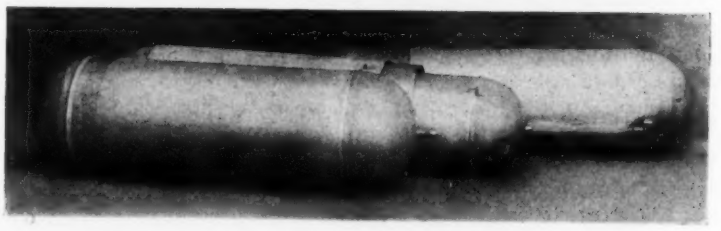


FIG. 12.—BRAUN ARTIFICIAL EARTH.

When receiving all extraneous electric waves are either reflected from the steath surrounding the aerial wire or transformed into oscillations which are conducted to the earth.

MARCONI AERIAL (SECOND FORM).—The aerials employed by Mar-

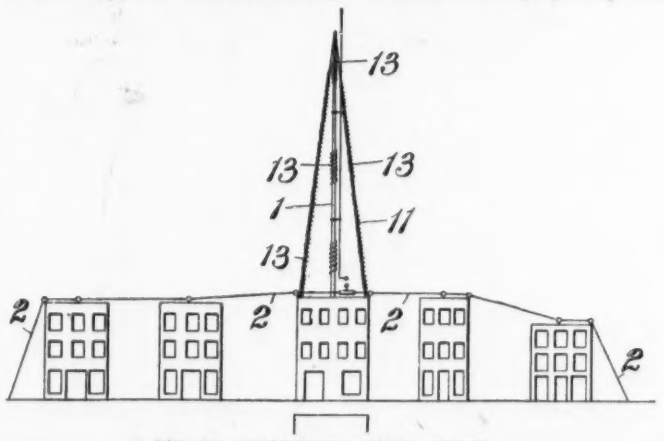


FIG. 13.—FESSENDEN WAVE CHUTE.

coni in his first syntonic system, composed of inner and outer metal cylinders, mark the first attempt to eliminate the high vertical wire as a factor in wireless telegraphy. Marconi has used single cylin-

[4]Cantor Lectures, Society of Arts, London, March, 1903.

ders of four or five meters in height in some of his experiments, and it is stated that messages have been sent and received a distance of twenty miles with their aid. A wireless telegraph automobile designed by this inventor for military purposes is equipped with an adjustable cylinder arranged to fold back on top of the vehicle when not in active service. It is illustrated in Fig. 9.

SLABY-ARCO DIRECT EARTHED AERIAL.—To Dr. Slaby and Count Arco is due the credit of having employed the sending and receiving aerials directly connected with the earth. Before the researches which led to this method it was the common practice to connect the lower free end of the aerial wire with one side of the spark-gap or coherer and the earth to the complementary side, but it was subsequently found that if the oscillators and wave detectors were connected to the aerial wire at a point where it found contact with the earth, as in Fig. 10, the potential of the oscillators was equally effec-

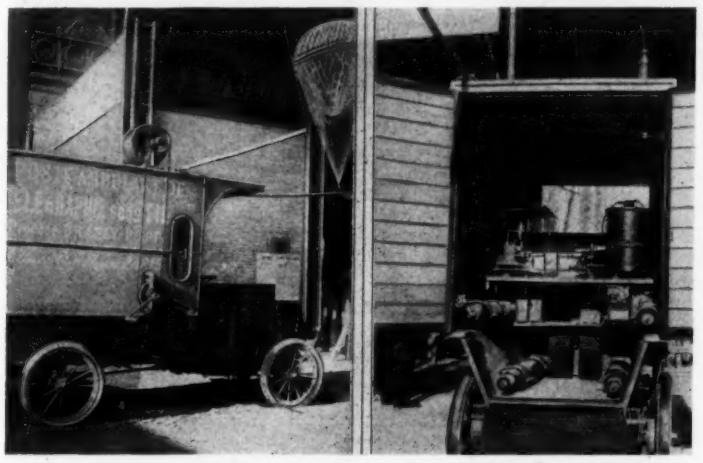


FIG. 14.—BRANLY-POPP WIRELESS TELEGRAPH AUTOMOBILE.

tive, while the discharge of atmospheric through the detector would be dissipated in the earth at *A*. In accordance also with the theory evolved, all waves received by the aerial which were not of a predetermined length will pass into the earth, since the nodal point is at *A;* the aerial wire should be in this case one-fourth the length of the wave it is desired to receive.

BRAUN NON-EARTHED AERIAL.—In Braun's system the radiator, Fig. 11, *A*, is connected with the primary of a transformer coil, *a*, whose opposite terminal is not earth, but is attached to a cylinder of copper or zinc, called an artificial earth, illustrated in the photograph, Fig. 12. This is one of the striking features of the Braun system and an original departure in commercial wireless telegraphy. It is claimed that this method effectually eliminates the disturbances due to atmospheric electricity.

DE FOREST MAST AND AERIAL.—One of the stations of the De Forest system is located at Steeplechase Park, Coney Island. It is equipped with a mast 210 feet in height; it is constructed of four

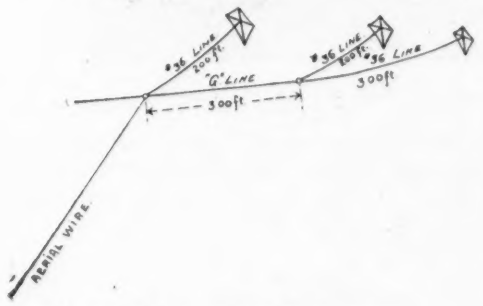


FIG. 15.—AERIAL ATTACHED TO KITES.

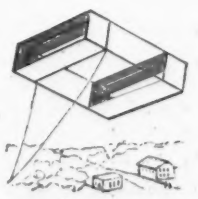


FIG. 16.—BLUE HILL BOX KITE.

poles set in crosstrees and supported by square bars of iron with a shoulder at one end to sustain the topmast over the head of the lower mast. These are termed fids; the mast is guyed to braces sunk into the sand sixteen feet deep. The guys are of wire rope with hemp rope terminals spliced to about 100 feet from the ground; the object of this combination is to maintain the insulation of the aerial cables, of which there are two supported by a yardarm near the top, and to prevent them from coming in contact with the guys.

FESSENDEN WAVE CHUTE.—In a recent patent granted to Prof. Fessenden additional data are given relating to aerials and grounds. This physicist has found it desirable to have a highly conducting surface over which the waves are propagated in the neighborhood of the point where they are generated, and that this highly conducting surface should extend to a distance from the point of their production at least one-fourth of the length of the wave in air and in the direction toward the station to which it is desired to send the

FIG. 17.—MALAY OR EDDY KITE.

message. The diagram, Fig. 13, illustrates the method for producing the desired results and is termed by Fessenden ***a wave chute;*** in the figure, 1 is the sending conductor, and 2, 2′, 2″ is the grounded conductor leading across building and other obstacles to a $\frac{\gamma}{4}$ beyond the limit of obstructions where the terminals are earthed as shown. The coils 3 and 4, forming guys from the mast, have a period of oscillation different from that of the antenna, and this with the grounded conductor or wave chute eliminates the interference of extraneous waves and serves to dissipate atmospheric potentials which occur in ordinary aerial wire systems. In practice Fessenden employs a sending wire having a large capacity and low inductance. The former is regulated by increasing the area of the

FIG. 18.—BLUE HILL BOX KITE IN FLIGHT.

aerial wire and the latter by adding to the number of turns of wire connecting the vertical wire with oscillator.

KITE-SUSTAINED AERIALS.—With the advent of the auto-coherer and current-actuated detectors came portable transmitters and receptors and the kite-sustained aerial wires. Heretofore one of the greatest obstacles to the successful transmission of wireless messages in military operations was the heavy accoutrements entailed by the use of masts, as these are much too cumbersome to be transported with the facility necessary in such all-important operations, and instruments without 80- or 100-foot aerials are useless. The kite and the balloon offer the solution. Kites are preferable, except in cases when there is no wind, and then small hydrogen gas-bags are useful. In the Branly-Popp wireless telegraph automobile ambulances and balloons are employed. The exterior and interior of these ambulances are reproduced in Fig. 14. Various forms of kites

especially adapted to the velocity of the wind may be obtained for elevating and sustaining the aerial wires. The aerial is attached to the kite as illustrated in Fig. 15. Aluminum wire, in virtue of its extreme lightness, makes a desirable vertical wire for this purpose. The transmitter and receptor utilizes the same vertical wire for radiating and receiving the waves, the change being made by means of an ordinary switch.

FIG. 19.—PORTABLE ARMY EQUIPMENT.

In very light winds the Malay, or, as its improved form is known,

FIG. 20.—INSTRUMENTS IN OPERATION.

the Eddy kite, is largely employed; it is shown in Fig. 17. These kites are fitted with a "bridle," which is already adjusted. To the ring or loop at the center of this bridle the end of the ball of kite-

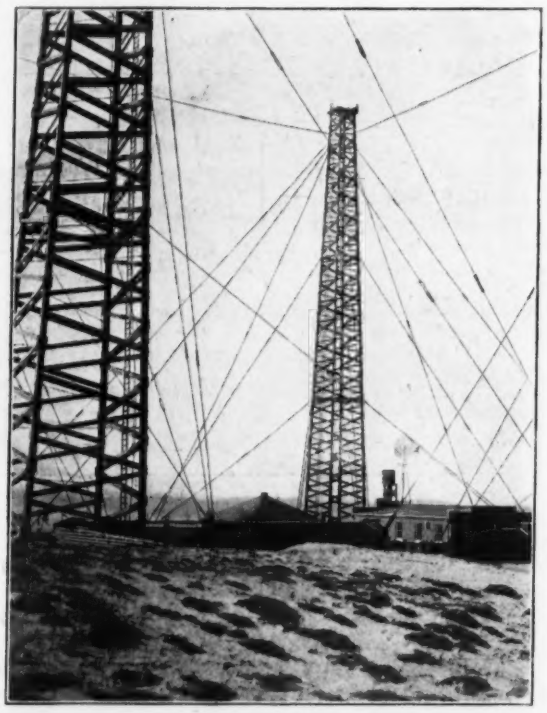


FIG. 21.—MARCONI SOUTH WELLFLEET STATION IN COURSE OF CONSTRUCTION.

cord is secured so that the knot is a firm one. These kites are tailless, may be flown in a very light breeze, and a number of the kites may be connected in tandem and their sustaining properties increased. In winds having a higher velocity the cellular or the American modification of it, known as the Blue Hill box kite, shown in Fig. 17 in outline, and a photographic reproduction in Fig. 18. It has a large sustaining surface and may be used in winds of ordinary velocities; in winds having a velocity of thirty or forty miles per hour a box kite having a very small sustaining surface is especially serviceable, since it possesses marvelous stability. Fig. 19 is a complete portable army equipment constructed by the Braun-Siemens and Halske Company for the German Government; it was placed in charge of the Royal Military Aerostat Battalion; Fig. 20 shows the aerial wire suspended from a kite and the instruments in operation. The transmitting apparatus includes a dynamo direct connected to a gasolene engine and is arranged on one while the receiver is placed on a second gun-carriage.

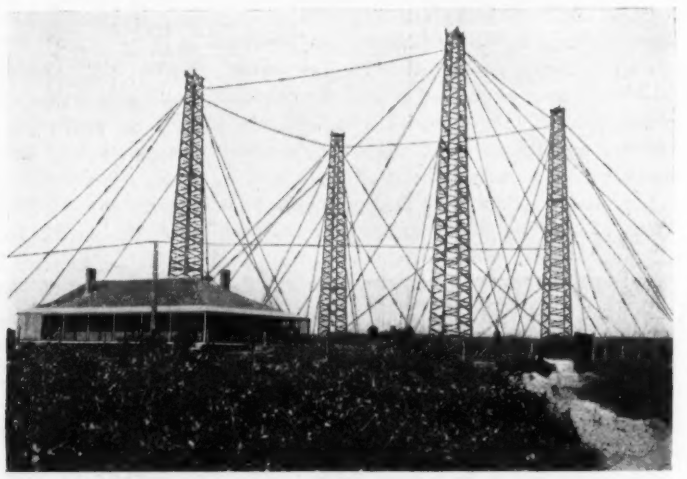


FIG. 22.—SOUTH WELLFLEET STATION IN COURSE OF CONSTRUCTION.

MARCONI CABLELESS STATION AERIAL.—The first transatlantic signals transmitted from the cableless station at Poldhu, England, on December 12, 1901, were received by a single aerial wire suspended from a kite at an elevation of 400 feet at St. Johns, Newfoundland. The kites employed during these aerial tests were constructed on the same general lines as those designed by Major Baden-Powell, consisting of a bamboo frame nine feet in height

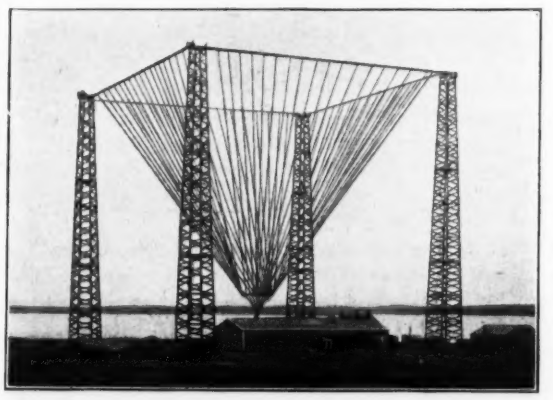


FIG. 23.—WELLFLEET STATION COMPLETED.

covered with silk and having a hexagonal form. The aerial wire passed through a window and was attached to a pole, and from this it led to the kite. The wire leading to earth forming the opposite arm of the resonator was suspended over the cliff from the station at Signal Hill and was connected to heavy plates of copper anchored in the sea. The aerial wires of the transmitting station at Poldhu, England, consisted of 15 vertical wires suspended from masts 210 feet in height and arranged in a circle. The construction of the multiplex aerials at Glace Bay, Nova Scotia, and South Wellfleet, Mass., cableless stations are designed especially for emitting long and powerful electric waves. Figs. 21 and 22 are photographs of the South Wellfleet station in the course of construction; four wooden standards 210 feet in height are arranged in a quadrangle and are sustained by guy wires, appearing as in Fig. 23 when completed; the aerial is composed of 400 wires forming an inverted pyramid; the upper terminals are insulated and the lower ends terminate in a single conductor of large dimensions. The opposite arm of the system is connected with several large metal plates deeply imbedded in the earth to make good contact.

Wireless Telegraphy in Russian Military Field Operations.

BY FRANK C. PERKINS.

THE accompanying illustrations, Figs. 1 and 2, show the power car and wireless telegraph transmitting and receiving car in use by the Russian army in the East, the system used being that of the Gesellschaft für Drahtlose Telegraphie, of Berlin, designed by Messrs. Braun, Slaby and Arco.

There are in operation at the present time about 40 transportable military wireless telegraph stations in the armies of the various countries of Europe using the apparatus shown in the accompanying illustration, which includes a power car, an apparatus car and an implement car, equipped for transmitting news from land to ship or from one army to another at distances of several hundred kilometers. These transportable stations are fitted with wireless telegraph apparatus for two wave lengths, a short wave of 350 meters

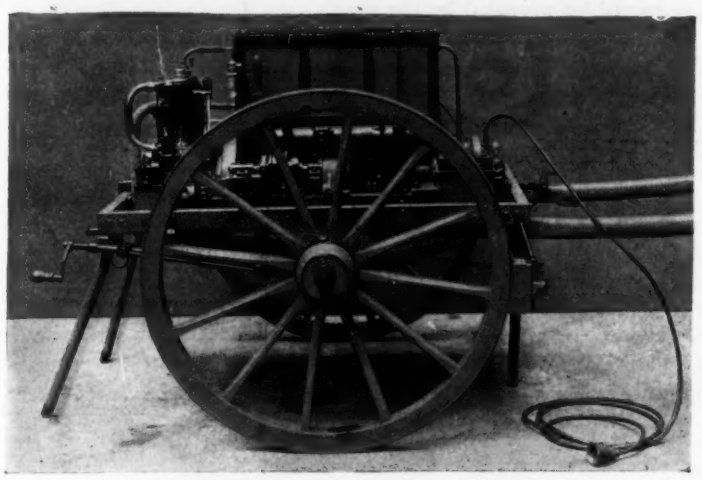


FIG. 1.—POWER CAR FOR RUSSIAN MILITARY WIRELESS TELEGRAPH SERVICE.

and a long wave of 1,050 meters. The outward balancing of the aerial wire is accomplished in the first case by a compensator of about 8 square meters of copper gauze, and 24 square meters to the second case, stretched out at a height of about one meter from the earth.

In some cases linen kites are employed and in others balloons are used to carry the aerial wire, the latter having a capacity of 10 cubic meters. The kite is employed with a light wind to economize the use of gas and has a useful wind surface of 1.1 square meter. The cart which carries the balloon and kite is a two-wheeled affair similar to those shown in the illustration, which latter carry the power generating apparatus and the receiving and sending electrical equipment. The implement car is provided with a gas reservoir and the necessary tools, as well as a reserve benzine reservoir for supplying fuel to the power car. The gas reservoirs are built directly in the car and hold about 5 cubic meters each at a gas pressure of 120 atmospheres, being tested according to legal requirements at 200 atmospheres. Two receptacles are sufficient for filling a balloon.

The power car which supplies the necessary current is equipped with an alternating-current dynamo having a capacity of 1 kw and a direct-current exciting dynamo directly coupled to a 4-hp benzine motor noted at the left in the illustration of the power car. This small engine is cooled by a circulation of water forced from a reservoir around the cylinder of the engine and through a ribbed pipe-cooling system by a small cog-wheeled pump, a ventilator or fan being utilized for cooling. The benzine tank is located near the water reservoir and has a capacity sufficient for a continuous telegraph service of 30 hours.

The engine is provided with electric ignition apparatus. Storage batteries are automatically charged by the continuous-current dynamo which supplies the exciting current for the alternating-current generator. The power car is also provided with a cable drum controlled by a conical friction clutch coupling to haul in the balloon. The engine has a maximum speed of 1,000 r.p.m., controlled by the igniting lever and the air and gas-mixing lever.

The apparatus car equipped with the transmitting and receiving devices is separated into two parts by a frame, one part containing the receiving apparatus and the other the transmitting apparatus. The high-tension equipment, the inductor, spark-gap and high-tension transformer are located in the forward part, while in the back part are installed a Morse register, two sets of receiving apparatus, a Morse key and a small receiving transformer below. Above on the frame is installed a large receiving transformer, the receiving plug and a counterbalance commutator with two levers.

On one of the doors, as shown in the illustration of the apparatus car, there is a sound-receiving device with an electrolytic detector and telephone, while on the other door there is a testing set, which can easily be removed. A storage battery is provided for lighting and an automatic switchboard for cutting in and out the current for charging the batteries. A plug box is arranged on the outside of the apparatus car with a connection for a conductor cable coming from the power car. There are also two cable drums provided on the sides, to one of which the stronger balloon is attached and to the other the lighter kite cable. The aerial wires are 200 meters long and cannot be varied in length for either the balloon or the kite, as the proper lengths are determined by the system. For replacing the earth connections in the usual system of wireless telegraphy, a balancing conductor is provided, consisting of an insulated metal plate or the copper gauze above referred to.

When transmitting with the long wave all of the transformer windings are switched in. In order to prevent the receiving apparatus being connected up by mistake while transmitting, the switch box of the receiving apparatus is so arranged that the wrong connections are impossible. It is very important that the intensity be regulated according to the distance between stations. For if the intensity is too strong the coherer might be injured. The intensity can be reduced by short-circuiting one or two of the three spark-gaps at the transmitter. The intensity in the coherer circuit may be reduced in several ways; the coherer possesses a wedge cleft, so that it is in its most sensitive position when the smallest opening is downward and vice versa. The receiving transformer may be regulated, the intensity being lessened by moving the outward or primary coil upwards, so that the secondary coil embraces it to a less extent. With distances of from two to ten kilometers the copper gauze compensator is not used, while with distances of from .5 to 2

FIG. 2.—APPARATUS CAR FOR RUSSIAN MILITARY WIRELESS TELEGRAPH SERVICE.

kilometers the aerial wire is not plugged into the receiving apparatus and under a distance of .5 kilometer the receiving apparatus is not switched in while transmitting.

By the use of the kite under favorable conditions or by means of the small balloon held captive by a fine steel wire, the Russian portable stations are able to communicate to one another with certainty over distances of 100 kilometers or more.

This system as employed in Germany is in charge of the balloon section of the German army and is said to have given excellent satisfaction during the last German maneuvers. It has also been adopted by Austria and, it is stated, is about to be introduced by Spain and Sweden.

Illinois State Electric Association Convention.

THE Illinois State Electric Association held its annual convention this year at Decatur, Ill., October 5 and 6. The first session was called to order Wednesday morning, October 5, by President W. E. McCollough, of Beardstown. Routine business was first disposed of. The reports of Secretary H. E. Chubbuck, of La Salle, and of Treasurer D. Davis, of Litchfield, were received. Eight new companies applied for membership at this convention, bringing the present membership up to 100.

After the routine business a discussion of fire insurance matters was taken up. It appeared that several members had been able to secure material reductions in insurance by very slight alterations in their plants in a number of instances. It was suggested that any member could study the matter of insurance rates and how to reduce them by securing a copy of the printed schedules giving the rate of insurance added for each additional item of risk in the arrangement of a plant and in this way learn how reductions in fire hazard and consequent rates of insurance could be made in their respective stations. Large savings could frequently be made by very small changes. A copy of these construction details and schedule of rates pertaining to them can be obtained from C. F. Persch, secretary Illinois Board of Fire Underwriters, First National Bank Building, Chicago. One member reported reducing his rate from $2.25 to $1.20 per $1,000 by studying his plant with a view to reducing the hazard in accordance with the insurance rules. It was finally decided to appoint a committee to notify the members by circular letter or otherwise of the possibility of reducing risks and insurance rates in many cases and also to call attention to some of the common hazards which can be reduced. It was felt that more practical good could be accomplished immediately by members trying to reduce their hazards, and so to secure rate reductions under existing insurance regulations and schedules, than to ask a committee to attempt the hopeless task of securing changes in the base rate on electric power plants. It was also suggested that such a committee might report to the State Board of Underwriters the introduction of undue hazards by the use of gasoline lamps in any towns in the State and that such action would be more likely to receive attention than a communication from the electric light company of a town. Several members testified to the great saving in insurance cost by insuring in the mutual companies.

Wednesday afternoon the convention took up at once the further discussion of questions filed with the secretary for the "Question Box." The first question was: "What economy is there in the use of compound as compared with single-expansion engines at pressures of 100 pounds or less?

R. S. Wallace, of Peoria, thought at full load about 10 per cent. economy over simple engines could be obtained if condensing, but not much without condensers. On fluctuating loads the economy was questionable.

The precautions necessary in paralleling alternators formed the subject of the next question. F. L. Lucas, of Pontiac, called attention to the necessity of being able to alter the adjustment of engine governors while the engines are running to make them take their proper share of load when driving alternating-current generators in parallel. This is easily done on Corliss engine governors by hand, but is not so simple on high-speed engines having shaft governors.

A question as to whether alternating-current motors have been used satisfactorily for crane and hoist work when supplied from lighting circuits was answered in the negative.

What are the objections to grounding the neutral of a high-tension, three-phase, star-connected generator? The answer to this was of course that such grounding was by all means the best and safest method to pursue.

What methods of voltage regulation have proven successful when single-phase lighting circuits are distributed across the phases of three-phase machines, when these machines also serve highly inductive load in motors and arc lamps? Induction regulators were said to accomplish this satisfactorily.

How often should such switchboard instruments as ammeters and voltmeters be tested to insure reasonable accuracy? Mr. Wallace, of Peoria, tests indicating instruments on the switchboard every six months. Integrating wattmeters measuring total station output are calibrated every two months, as they are instruments in which errors are so important.

G. H. Lukes, of Evanston, thought switchboard voltmeters should be compared with a standard voltmeter of known accuracy every one or two months because the maintenance of correct pressure is so essential in operation. With switchboard ammeters accuracy was usually not so important as with voltmeters.

What method of treating wooden poles seems to give the best result in preserving tops and butts from decay? No evidence was presented showing any practical advantage at present in treating poles in any way. Mr. G. C. Kinsman, superintendent of telegraph of the Wabash Railroad, said probably the best answer to the question was the fact that the Western Union Telegraph Company with its years of experience uses poles not treated or painted in any way. Even cross arms are not painted, as paint simply covers up poor timber and may result in holding the sap in green timber to its detriment. The life of Western Union poles is 8 to 24 years, averaging 16 years.

The convention then adjourned to give attention to the exhibits of new specialties provided by the supply men.

On Wednesday evening the Decatur Railway & Light Company entertained the attendants at the convention by a theatre party to see the play "Buster Brown." After theatre, the Mueller Manufacturing Company, of Decatur, gave a "Deutsche Lunche" to the party. Special cars were in waiting to take the crowd to the company's factory, where the lunch was served. After the repast a few remarks were made by Mr. Mueller, President McCollough, Senator J. N. C. Shumway, the Mayor of Decatur, and others. The Mueller quartet provided music. The company's hospitality was much appreciated.

Thursday morning the question box was again taken up. Is it advisable for small plants to connect with adjacent towns having a population of 800 to 1,000, the distance being six to eight miles? The several answers to this were that it is being done in a number of cases successfully and presumably is advisable.

The next question related to the method of determining ratio of current produced to current sold. C. L. Gerould gave as an example a plant at Bloomington, Ind., where the difference in total readings between switchboard wattmeters and customers' wattmeters is 33 per cent.

J. B. Lukes cited one plant in a suburban residential district near Chicago where the difference was 30 per cent. when the service was during the night only. When the change was made to 24-hour service the difference was 50 per cent. The difference between current produced and current sold depends very much on the kind of circuit and the load factor. The better the load factor the less the difference. The highest loss would be in rich residential districts, where the transformer capacity is high in proportion to the load and where, because of the size and distance between residences, there cannot be many customers on one transformer. He said the best results in studying losses could be obtained by taking one circuit at a time. The average results for a whole system would not throw much light on the conditions on any one circuit.

The joint occupancy of poles by electric light and telephone companies was discussed. Messrs. Shumway and Lukes did not like such arrangements because of friction likely to arise between the companies.

R. A. McLaughlin, of Galesburg, rather favored such joint use and showed that the telephone lines should be placed lowest on the poles, as they are likely to break the most frequently and require linemen's attention and are the less dangerous to climb through of the two classes of wires.

W. J. Ferris, of Monmouth, told of his experience at Somerville, Mass., where some five companies were required to use each other's poles wherever practicable on the same street. The company owning the pole received a rental of 25 cents per hitch per year, or 35 cents for a two-wire circuit, from the other companies occupying the pole. He preferred to use a pole jointly with another company rather than have two pole lines on the same side of the street, as it was better for both companies.

Mr. Xenophon Caverno, of Kewanee, thought the managers might agree perfectly, but it is difficult to keep the linemen of the two companies on peaceful terms. Other members showed this trouble would be just as bad or worse if the companies did not occupy the same poles.

J. R. Stanley, of Joliet, told of the very satisfactory arrangements for the joint occupancy of pole lines in Joliet.

How often should meters be tested? Mr. Ferris, of Monmouth,

watched customers' bills from month to month and if there was any reason for suspicion that the meter was fast or slow it was tested at once.

F. L. Lucas, of Pontiac, thought about once a year as often as a small plant could afford to test meters. John F. Gilchrist, of the Chicago Edison Company, thought that for customers having bills of $5 per month and less a meter test once a year was sufficient. The larger the customer and the more money involved the more frequent should be the test of the meter. He cited cases where a number of meters had been found running 10 per cent. slow after 90 days. In 8 cases out of 10 incorrect meters will run slow rather than fast.

Resolutions were passed thanking the Decatur Railway & Light Company for entertainment and special cars, the Elks Lodge of Decatur for the use of its club rooms for the meetings, the Mueller Manufacturing Company for the luncheon and the electrical and local press for attention given to the meetings.

Officers for the coming year were then elected as follows: President, E. B. Hillman, of Warsaw; first vice-president, Xenophon Caverno, of Kewanee; second vice-president, B. H. Abbott, of Petersburg; third vice-president, J. A. Carothers, of Pontiac; fourth vice-president, E. S. Hughes, of Olney; treasurer, C. A. Vallette, of Edwardsville; secretary, D. Davis, of Litchfield. Executive Committee—W. B. McKinley, of Champaign; J. N. C. Schumway, of Taylorville; Frank J. Baker, of Chicago; H. E. Chubbuck, of La Salle, and S. S. Davis, of Rock Island.

On Wednesday afternoon after the close of the convention the members and supply men were taken on a special car over the new interurban line of the Illinois Traction system from Decatur to Springfield, which is one of the lines built recently by the McKinley or Portland syndicate, which controls such an extensive mileage of interurban lines in Illinois. The party was met a short distance out of Decatur by Superintendent R. D. Smith, of the company. At Riverton the car was stopped an hour for a visit to the new power house which is now supplying 80 miles of road (Decatur to Carlinville) and presents some very interesting engineering features. Arriving at Springfield the party broke up.

Pennsylvania State Independent Telephone Association

In accordance with the plans already announced, representatives of independent telephone interests in Pennsylvania met at Harrisburg September 27 and organized the Pennsylvania State Independent Telephone Association. Officers were elected as follows: President, Hon. B. F. Meyers, Harrisburg; vice-president, R. E. Flinn, Pittsburg; second vice-president, Charles Griffith, Johnstown; secretary, H. E. Bradley, Philadelphia; treasurer, C. E. Wilson, Philadelphia. The members of the Executive Committee are B. F. Meyers, Harrisburg; C. E. Wilson, Philadelphia; R. E. Umbel, Uniontown; E. D. Schade, Johnstown; C. W. Kline, Hazleton; J. G. Splane, Pittsburg; W. D. Barnard, Philadelphia, William B. Trask, Erie, and G. B. Rudy, York.

On the morning of September 28, the association being an actuality, it was welcomed by Hon. Vance C. McCormick, whose greetings were responded to by Mr. W. H. Denlinger, of Patton, Pa., on behalf of the new-born association. At the afternoon session papers were submitted and read as follows: "Long-Distance Service Equipment," by S. H. Browne, Pittsburg; "Telephone Auditing," by I. D. Gindhart, Jr., Philadelphia; "Progress of Independent Telephony," by W. Scarlett, Harrisburg; "Telephone Exchange Equipment," by Charles Russell, Philadelphia; "Traffic Associations," by H. E Bradley, Philadelphia. Abstracts of the last two papers will be found on other pages.

In the evening a banquet was held at the Harrisburg Board of Trade, the president, Hon. B. F. Meyers, acting as toastmaster. Addresses were made by the following-named gentlemen: Hon. H. E. Critchfield, Chicago, Ill.; Col. A. L. Tetu, Louisville, Ky.; R. C. Hall, Pittsburg, Pa.; Col. C. M. Clement, Sunbury, Pa.; Hon. William Bunn, Philadelphia, Pa.; Edward E. Clement, Washington, D. C.; J. B. Hoge, Cleveland, Ohio; J. B. Ware, Grand Rapids, Mich., and Bert S. Hubbell, Buffalo, N. Y. In his opening remarks President Meyers spoke of the success of the organization of the Pennsylvania State Independent Telephone Association. He considered the independent telephone movement a great moral agent. The old monopoly, he said, gave such poor service that a great deal of profanity at one end of the line resulted. He concluded by calling upon Mr. H. D. Critchfield.

Mr. Critchfield presented some interesting facts. In 1895, he said, the annual report of the American Bell Telephone Company showed that there were 323,000 telephones in use in the United States. Of these less than 5,000 were independent. The independent movement, he said, practically began that year, although it really started in McKeesport, Pa., in 1890. In 1895 the Bell people had in their employ practically everyone who knew anything about telephony. They had all the patents. The independent people had to make men to make their machines. The monopoly had the public scared. In nine short years the number of independent telephones had grown to more than 2,400,000—ten times as many as the Bell system had from 1877 to 1895. To-day the Bell system embraces about 1,250,000 telephones. Mr. Critchfield emphasized the need for good local service, conceding at the same time the worth of the long-distance. He said that the average man would rather have connection with the post-offices in his own county and with half a dozen farms in his own county than with New York, Boston, St. Louis or Chicago.

Treasurer Hall, of the Pittsburg and Allegheny lines, awakened enthusiasm when he emphatically declared the paying qualities of the independents. It is a business which has proven its ability to pay at least from 3½ to 4½ per cent. Like the steam, traction and gas companies, it has proved its right to exist.

Mr. A. L. Tetu, of Louisville, said that for two years the independents have been in Louisville. When the exchange was established there the number of telephones in the city numbered 2,000; now there are 14,000, the independents having 1,000 more of them than the Bell. None of the independents are free instruments, while the Bell people give them away on sixty or ninety days' trial. He attributed the success in Louisville to the fact that the interests are localized, and the same is very likely true elsewhere.

Former Governor William H. Bunn, of Philadelphia, was next introduced. Mr. Bunn's address was confined principally to Philadelphia and the independent telephone work being done in that part of the State furnished the basis for his eulogy of the city.

The infant association being duly nourished, the first meeting was brought to a close. The attendance far exceeded the expectations of those who promoted the movement, every section of the State being well represented. Altogether it was an enthusiastic and successful gathering.

The Marvels of Municipal Ownership in London.

The subjoined item of very interesting information is from the *Milwaukee Free Press*. We feel that it would be wanting in duty on our part to keep it from the electric lighting readers of this journal. It is true that the number of arc lamps is greatly understated and that the cost is very much overstated, but those are trivial details. The general belief here has been that London had 50,000,000 arcs in operation at a cost of $1 per year each, and used up only one coal mine each 24 hours in performing this brilliant feat of furnishing every citizen with ten arc lights per capita, every night and all night. But the wonders of municipal ownership never cease. The entire item follows:

"Only $11 for an arc light.

"That is what the city of London, England, is now paying with municipal ownership.

"Frank Spencer, an electrical engineer in St. Louis, at the St. Charles Hotel the other day, said of London's plant:

"'I was in London a few months ago and paid a visit to the lighting plant there. It is one of the most complete in the world. It is located in the East End and, with some smaller stations, furnishes electricity for 4,500,000 arc lights.

"'The lighting costs the municipality about $50,000,000 a year, or slightly over $11 a lamp. The main plant consumes about 2,000 tons of coal a day in the summer and three times that during the longer winter nights. Coal is bought in installments of 60,000 tons. Storage bunkers holding nearly that amount always are kept filled in view of possible strikes or other emergencies.

"'There are 40 boilers with a capacity of 1,000 hp each, supplying power to operate half a dozen 3,000-hp dynamos and one 6,000-hp dynamo. Sufficient voltage is carried by the main cables to kill an army of 90,000 men. There are 3,000 miles of cable in the city connected with the electric lighting plants.

"'The sum of $50,000,000 for lighting each year seems pretty large. But when you consider the average cost per light, it is cheaper than you find in American cities.'"

Electrical Jury at St. Louis.

We are glad to be able to present to our readers herewith an excellent portrait group of a number of the leading members of the electrical jury at St. Louis, whose work has reached its termination recently. The picture includes Jacques Holzchuch and Gaston Roux for France; Prof. Guido Grassi for Italy; Dr. Kahle, Germany; Dr. C. F. Drysdale, Great Britain. The Americans in the group are Mr. W. V. N. Powelson, chairman; Cloyd Marshall, secretary; Prof. W. E. Goldsborough, Department of Electricity, and Messrs. Carl Hering, William J. Hammer, Harold B. Smith, J. E. Smith, Dr. E. B. Rosa. The details of the work of the electrical jury have not yet been made public, but are awaited with interest.

Telephone Traffic Associations.

Mr. H. E. Bradley, superintendent of the Eastern Traffic Association of Philadelphia, in a paper read before the first convention of the Pennsylvania State Independent Telephone Association, held at Harrisburg recently, said that the time will soon come, if indeed it is not already here, when the proper handling and accounting for long-distance messages will become a vital question to all independent companies. While it is a fact that there is more independent capital invested, and more independent telephones in use, than the combined interests of the Bell can show, the larger part of the capital is locally invested, and the consequence is that the independent companies, with perhaps a few exceptions, are not able to give strictly commercial long-distance service. There are many independent companies who are at the present time operating lines more than 100 miles in length, and giving perfect service. There are also many cases where separate companies are interchanging business with equally good results. But the trouble generally comes when messages are originated in the territory of one company, pass over the lines of one or more intervening companies, and terminate in the territory of a third or fourth company. These troubles may arise from any one of a number of different causes. It may be in the transposition, a poor connection in the board, or a trivial mistake on the part of a careless lineman. Take two separate lines of two different companies working perfectly and connect them together, and it is the rule and not the exception that they will become noisy, out of balance and practically useless for commercial service. All these little troubles must, of course, be found and corrected, but up to the present time there is too much of a tendency to lay it to the other fellow, and until the time comes when the companies are more willing to get together and give and take, and by so doing overcome these little troubles, toll business must suffer.

The author referred to the success of independent local companies against the Bell opposition, and from these traced the growth of toll service, which finally leads to long-distance service and its many complex problems in the way of accounting and settlements. How are these settlements to be made with fairness to all in the shortest space of time and at the least expense? A great many of the independent companies, he said, have found the answer to these questions in the Traffic Association, an organization which has an equal interest in all its members, large or small, and yet is partial to none, treating all with the same degree of fairness. The object of the association is to promote interchange of business between its members, to publish all necessary rates and routing directions and to facilitate settlements. Instead of making five separate reports each company now makes but one, and that to the association. The association checks and settles all differences and divides equally, fairly and impartially all tolls. It acts as a court of arbitration where all disputes and misunderstandings can be adjusted and extends to all its members, large or small, the same advantages and benefits. One of the greatest benefits to be derived through the organization of an association is the publishing of rates and routings in book form, showing the proper toll charges between all exchanges and the different routes over which the messages may be carried, together with a complete list of checking and other line points. This work, if done by the individual company, would become a very large item of expense, but by centralizing the work in the association and combining all under one cover, a most valuable book is obtained at a minimum of cost. The secret of the success of the Bell company in long-distance work, he said, lies in the fact that it is controlled by one company and governed by one system.

Cloyd Marshall. W. J. Hammer. Dr. C. V. Drysdale. Dr. Kahle. Gaston Roux. H. B. Smith. Carl Hering.
J. Holzchuch. Guido Grassi. W. V. N. Powelson. J. E. Smith. Dr. E. B. Rosa. Prof. W. E. Goldsborough.

MEMBERS OF THE ELECTRICAL JURY, ST. LOUIS EXPOSITION.

Overhead Wires in Baltimore.

Building Inspector Preston, under instructions from Mayor Timanus, is cutting down overhead wires in the business districts, in consequence of the failure of the electric companies to comply with a thirty days' notice to place these wires in the municipal subways recently constructed.

Steam Turbines.

Two papers were read this week before the St. Louis Convention of the American Street Railway Association on steam turbines, one by Mr. Richard S. Rice having the Curtis turbine for its subject, and the other by Mr. J. R. Bibbins entitled "Steam Turbine Power Plants" and dealing with the Westinghouse-Parsons turbine.

Mr. Rice gave a list of Curtis turbines now made of small sizes from 1½ to 300 kw, no gearing being used in the corresponding turbo-generators. Following is an enumeration of these small machines, of which it is stated a number are now in commercial use giving good satisfaction, and a still greater number in course of construction, all of the horizontal type, and the three smaller sizes are governed by throttle valves:

Rated Capacity, Kw.	Speed of Shaft, R. P. M.	Condensing or Non-condensing	No. of Stages.	Current.	Poles.	Voltage.
1½	5,000	Non-cond.	1	Dir. cur.	2	60
15	4,000-4,500	Non-cond.	1	Dir. cur.	2	80-125
25	3,600	Non-cond.	1	Dir. cur.	2	125-250
75	2,400	N-c. & cond.	2	Dir. cur.	4	125-250
100	3,600	Cond.	3	Alt. cur.	2	2,300
150	2,000	N-c. & cond.	3 & 4	Dir. cur.	4	125-250
300	1,800	N-c. & cond.	3 & 4	D. C. & A. C.	4	250,500 & 2,300

The 15-kw set was first used for train lighting service and a number are now employed for this purpose. Some are placed on the buffer beam of the locomotive, and others are installed in the baggage car. The latest forms are also so equipped as to be capable of being put on top of the boiler just in front of the steam dome when desired. The conditions of service are widely different on the locomotive and in the baggage car. In the former case the turbine is supplied with steam at 175 pounds to 200 pounds pressure and exposed to great variations of temperature.

Some of the 25-kw sets are also used for train lighting in the baggage car. The smaller sets are well adapted for the excitation of the fields of large generators, as well as for general purposes. The floor space required is small, the regulation is equal to that of reciprocating engines, and the sets are automatically lubricated and require little attention.

The operation of direct-current commutators at the speeds in question has necessitated the development of various special features in the commutator. Carbon brushes are used throughout, the best form of brush being one which has been treated without lubricant, and with this form of brush commutation is very satisfactory. On account of the high speed and great length of the commutator bars they are provided with nickel-steel shrink rings at the ends and middle of their lengths to prevent deflection. These rings are shrunk on over insulation and provide a very effective means of supporting the commutator bars and also have the advantage of giving a greater wearing depth of copper than the usual construction.

The steam consumption curves of these small turbines differ somewhat in characteristics from those of large turbines of the same type, in having a comparatively high steam consumption at light loads. This is because the fixed losses, such as bearing friction and windage of the wheels are a greater proportion of the total output. Curves accompanying the paper show the following steam consumption: 15-kw set, full load, 60 pounds per kw-hour; half-load, 80 pounds. 25-kw set, full load, 55 pounds; half-load, 77 pounds. 75-kw set, full load, 46 pounds; half-load, 55 pounds. The above consumptions refer to non-condensing working. The consumption of the 100-kw set working condensing is 25.5 pounds full load and 28.5 pounds half-load. In all of the above cases the consumption at quarter over load is considerably less than at full load.

The paper by Mr. J. R. Bibbins on "Steam Turbine Power Plants; Notes on their Equipment and Operation," contains much data relating to the performance of the Westinghouse-Parsons turbine. It is pointed out that while the reciprocating steam engine reaches its point of maximum economy at about .8 full rated load, the steam turbine has its maximum efficiency at about full load. Expressed in practical terms this means that with turbines less power machinery is required for a given load. It is maintained that comparisons as to the performance of multiple expansion reciprocating engines adverse to the turbine are unfair when the comparison is made on a basis of ideal conditions for the former and normal operating conditions for the latter; nor should a comparison of the two types be made upon a vacuum of 25 in., since the reciprocating engine is not able to take advantage of higher vacuums, while the turbine increases largely in economy above this, the increase being 3½ to 4 per cent. for each inch of vacuum above 25.

A number of tables of tests are given. In the case of 750-kw Westinghouse-Parsons turbines built for the Boston Navy Yard and the Manila tramways, the steam consumption was as low as 11.42 pounds per brake hp-hour, the vacuum being 27.99 in., the steam pressure 149.9 pounds, and the superheat 152.2°. With 28 in. vacuum and no superheat, the consumption of steam was 13.77 pounds, 23.46 pounds with no vacuum and 100° of superheat, and 28.26 pounds without either vacuum or superheat. In subsequent tests with another turbine of identical design the consumption was found to be 11.5 pounds at 28 in. vacuum and 150° superheat, and 13.05 pounds with 26 in. vacuum and 140° superheat. With 182° superheat and 28 in. vacuum the consumption was 11.17 pounds, which reduced to the base of indicated horse-power is equivalent to 10¼ pounds per hp-hour, and approximately constant throughout a wide range of load. Comparative data are given of 46 turbine plants varying from 400 to 40,000 kw capacity and employed in a large variety of services, the total capacity of the 46 plants being 146,750 kw, or an average of 3,125 kw per unit.

As to the power consumption of auxiliaries, a table of test data is given taken at the plant of the Johnstown, Pa., central station. At full load the total power taken by the auxiliaries was 2½ per cent. at full load and was less than 5 per cent. at one-fourth load. At the full rating of the condenser the power consumption would approximate only 2 per cent. of the turbine output. The paper deals extensively with condenser arrangements and concludes with some interesting information concerning the reliability of the operation of the turbine, which is reprinted below.

In a railway and lighting plant, a 400-kw Westinghouse-Parsons turbine ran from April 24, 1903, to September 11, 1904—505 days—on 24-hour railway load without being opened for inspection. Another ran nearly as long. Both steam pressure and vacuum were low, and the steam was so wet that at one time seven barrels of water collected in the exhaust main during a 10-hour run; yet on a recent inspection no deterioration was noticeable. It has frequently been slowed down by quantities of water in the steam. This turbine has carried 15 per cent. overload for fifteen consecutive hours, it has operated the entire railway and lighting system for nine hours without vacuum, and has operated successfully in parallel with another turbine and with compensated field alternators belted to high-speed automatic engines. During erection it slipped from a temporary staging, fell 6 ft. and landed bottom side up; no injury has ever resulted.

In another railway and lighting plant, a 400-kw turbine system ran 375 days, 24 hours each, with but 3 per cent. shutdown, less than 1 per cent. of which was chargeable to the turbine; the remainder to vacuum pump, steam piping, etc. In this plant the steam has been extremely wet and contained much foreign matter carried over from the boilers.

In an industrial plant at Stamford, Conn., after eleven months' continuous operation of a 400-kw unit, the original shop oilstone marks on the bearings were plainly visible. This turbine ran five consecutive hours at 50 per cent. overload. During the winter it runs non-condensing part of the day, supplying 32,500 sq. ft. of heating surface.

In an industrial plant at Akron, Ohio, one 400-kw and one 750-kw turbine operate in parallel, with the greatest ease, with two 500-kw and one 150-kw direct-connected Corliss engine units upon a widely fluctuating factory load, due to electric motors, many of which are of 100 to 300-hp capacity. The turbines exert an important corrective influence over the regulation of the entire plant.

In an electric light and power plant at Hartford, Conn., a 1,500-kw unit has been started cold and load applied in seven minutes. It has carried a load of 2,200 kw for 30 consecutive hours. It operates regularly in parallel over a high-tension transmission line with a water power station eleven miles distant.

In a railway plant at Elyria, Ohio, a 1,000-kw unit has carried a load of 1,675 kw, and operates 21 hours daily on a railway load frequently fluctuating from 100 to 3,000 amp. in two or three minutes. It operates in parallel with another unit of the same size, supplies some power for lighting, and has more than halved the cost of coal per kw-hour of the engine station.

In the electric light and power station of Newcastle-on-Tyne, England, a turbine installed in the Neptune Bank station made the following record, as shown by the station log: Out of 7,512 hours' run—from December, 1901, to December, 1903—the turbine was out of commission 52 hours, or 0.7 per cent. of the running time. Repairs comprised the relining of the governor throttle valve chest and the renewal of an oil disc.

Maintenance and Inspection of Electrical Equipment.

Mr. John Lindall, general foreman of the shops of the elevated division of the Boston Elevated Railway, read a paper with the above title on Tuesday at St. Louis before the American Mechanical and Electrical Association, in which he laid stress upon systems of written reports and proper recording and tabulating of defects. He referred to the good results that would follow through training of motormen and of electrical inspectors and repairmen. As two-thirds of the cost of maintenance is chargeable to the labor account, careful attention should be given to instructing and retaining in the service competent men. The development of men to care for the equipment has not kept pace with the development of the equipment itself and, therefore, extra inducements should be held out to attract reliable and capable young men to the service. Men should be taught why, as well as how, to work, and they should study effects to find causes and not guess at the latter. As an example, a controller which has been flashed shows just as clearly as a photograph the position of the cylinder at the time of trouble, and it is thus easy to determine whether it is a case of hot touch, insulation breakdown or lack of current-handling capacity.

Under the system of inspection in the Boston Elevated surface lines, trolleys, switches, controllers and motors are inspected after three days' service, though brushes and armature grease cups on some motors which are in severe service are inspected every day. According to this system an inspector is not required to do anything but inspect and make very light repairs, equipment requiring extra attention being reported to the foreman, who details repairmen to do that work. Repairs to the electrical equipment are not made in the car houses, but sent to a repair shop, at which are also manufactured field and armature coils, commutators, motor bearings, brush-holders, trolley wheels, contact fingers, etc. Referring to flash-overs, Mr. Lindall considers that the remedy appears to lie in increasing the size of motors so as to render them less sensitive. The principal details of inspection are enumerated as follows:

Trolleys, to see that pole is straight and securely fastened, that the harp is tight in the pole, and that there are at least three days' wear in the wheel; that contact springs, washers, bushings and spindles are not seriously worn and are properly lubricated.

Controllers, to see that they are clean and properly lubricated, that contacts make and break at proper points, that fingers and tips are sufficient for at least three days' wear and that they are not rough and cutting; that cut-out switches work properly, and that wires are firm and show no evidence of heating at terminals.

Main switches, fuse boxes and lightning arresters, to see that contacts are sufficient and in good condition, and that wires are secure in terminals.

Resistance, to see that they are not seriously burned, that they are secure, and connections firm.

Motors, to see that connections and leads are secure and not chafing, also that brushes are not broken and are good for three days' wear, that the brush-holder insulation is clean, and sufficient tension in springs, that commutators are clean and smooth, that bearings are properly lubricated, that there is sufficient clearance between armatures and pole pieces, that pinion and gears are tight, that motor gear case and axle collar bolts are tight, and that the casings are not cracked.

The monthly inspection consists of opening up motors for inspection and cleaning, lubricating and cleaning trolley stands and trolley catchers. Controllers are taken apart yearly, thoroughly cleaned and painted and insulating material shellacked. The wires are also inspected yearly for insulation weakness.

Telephone Exchange Equipment.

In a paper on "Exchange Equipment," by Mr. Charles Russell, read before the convention of the Pennsylvania State Independent Telephone Association, held at Harrisburg, September 27 and 28, the author pointed out that this subject is one which concerns every person who has any connection with the telephone business, either as a subscriber, a casual user, or those who are directly concerned in financing, operating or maintaining such equipment. The subscribers are interested to the extent that they desire to get the results of telephone service with as little effort as possible on their part, which is clearly demonstrated by the difficulties experienced by the traffic department. To those who are interested financially the equipment is of great importance from the fact that there is so much money piled into so small a space. Few men who are not acquainted with an equipment in any other way than dollars and cents invested and the interest obtained from the investment, can be persuaded to recognize the necessity for investing so much money for this part of a system. In a multiple board which provides for 5,000 subscriber lines there are about 85,000 jacks at a cost of about $150,000. The cost of equipment seldom runs less than this, but in large boards they cost many times more.

Mistakes occur in the maintenance, which are frequently due to the idea that the equipment does not require attention. This is very often the case with new companies who do not place their equipment in good hands until it has so deteriorated that it is practically beyond redemption. Such conditions are often followed with a case of telephone malaria, which can only be cured by a large dose of receivership, or some proceedings through which the originators lose their money. It is a fact, however, that few persons have regretted entering the telephone field, where good engineering, construction, operation and maintenance have been secured. There are three officials who must work together in harmony, viz.: the engineer, who provides an equipment of the highest efficiency and is ever alert to secure for the public the very best transmission to and from all points, either local, toll or long distance; the superintendent of maintenance, whose duties are to keep the equipment in perfect working order, and the traffic manager, who handles the business for whom all others are providing a means for accomplishment.

Recent Electrochemical Developments.

ELECTROLYTIC PROCESSES.

In the processes now in use for the electrolysis of common salt—either in solution or in the fused state—the products obtained are chlorine at the anode and caustic soda and hydrogen at the cathode. Of these three products, caustic soda is commercially the best paying one. Chlorine is used to the greatest extent by far in the manufacture of bleaching powder, but in view of the situation of the market the net revenue from bleaching powder is small.

In a patent granted to F. von Kuegelen and H. Danneel, the attempt is made not to produce hydrogen at the cathode in the free state, but to utilize it for the reduction of a metallic oxide. The inventors describe the application of their principle in the case of the reduction of tin from tin-oxide. They use a fused solution of sodium chloride and the anodic development of chlorine is the same as in other processes, while the sodium ions discharged at the cathode reduce the tin oxide, with the formation of sodium oxide and metallic tin. The tin is, of course, obtained free from carbon—which is an advantage over the reduction of tin ore in metallurgical furnaces by means of carbon. The efficiency of the electrolytic process is claimed to be high, and it is said that the voltage required is lower than that needed for the decomposition of sodium chloride when hydrogen is produced at the cathode.

A patent recently granted to Jacques Oettli refers to the electrolytic production of zinc-white. If a current is passed between zinc electrodes through a warm solution of sodium sulphate (temperature about 60° C.) zinc sulphate is formed at the anode and sodium hydroxide at the cathode, while simultaneously hydrogen is developed at the latter. The zinc sulphate and sodium hydroxide react together to precipitate insoluble zinc hydroxide, which is separated from the solution by filtration and afterwards changed to zinc-white.

ELECTRIC HEATING MATERIAL.

In a recent patent, granted to A. Voelker, an attempt is made to devise a cheap and simple resistance material which, according to the proportions used in the mixture, may be used to produce any desired temperature within a rather wide range. His resistance material consists of a mixture of fine granulated amorphous carbon, graphite and silicates. According to the temperature required, the material is heaped up in a more or less finely granulated powder to a greater or less height around the object to be heated, such as a crucible, muffle, furnace chamber and the like. The scheme is to classify the granulated carbon in seven different classes containing grains of 1 mm. diameter, 2 mm. diameter, * * * 7 mm. diameter and then graduate each of the groups by the addition of graphite or silicates, the addition of graphite increasing the conductivity of the mixture, while that of silicates diminishes it.

New Telephone Patents.

NEW SWITCHBOARD CIRCUITS.

W. M. Davis, of Chicago, has recently patented a new circuit system for common battery switchboards, especially designed to prevent "clicks." The normal current supply to each line is practically constant, being fed through the two windings of the line relay. These windings are connected cumulatively and serve as a retardation coil. A cut-off relay to cut out the line signal operates upon the insertion of a plug in the jack. This relay is so connected in as to have inappreciable effect upon the line current. Neither does connection of the cord circuit have much effect as no current is supplied over it, the supervisory relays of very high resistance being bridged directly across the circuit and receiving current from the line. This circuit depends for its proper action upon the fact that the relays are of so great resistance as to become practically short-circuited by a telephone set, if the receiver be off the hook.

A second circuit patented by Mr. Davis deals with through supervision on toll lines. In this, as in the preceding system, the action of the system depends upon some of the relays being wound to such high resistance as to be deprived of so much current as to fail, if a telephone set be connected in multiple circuit with them. The patents for both of these circuit systems are assigned to the Stromberg-Carlson Company.

APPARATUS FOR THROUGH RINGING ON PARTY LINES.

By through-ringing is meant the ringing of a subscriber connected to one switchboard by the operator of a distant central office. For example, if two subscribers of different districts be connected together by a trunk line and either be rung by the operator of the other, the signal is a "through-ring." With common battery systems, having trunks operated upon a one-way, or calling circuit basis, it is found necessary to include a repeating coil in the trunk circuit, and this repeating coil so far absorbs the ringing current as to defeat the signal. Under ordinary conditions of operating, the inability to ring through is of little moment. For toll business, on the other hand, it becomes practically necessary to accomplish it. Several systems have been adopted which provide for the through-ringing feature, but the most valuable of these consists of a tandem arrangement of relays such that when a distant operator depresses her ringing key, the current put upon the trunk line actuates an alternating-current relay, which in turn actuates a ringing relay. This latter serves to clear the subscriber from the disturbing repeating coil and ring him directly. Such a system works out satisfactorily until it becomes necessary to distinguish between stations equipped upon a selective party line system. To meet this condition, modification must be made, in the form of a set of switching keys. These vary the current supply to the ringing relay so that the proper station only is signaled. The operation of the switching keys is assigned to the trunk operator. She, after receiving a call, not only connects a trunk to the line desired, but also at once sets the ringing switching key to correspond with the station desired.

Such is the system to which a ringing apparatus patented by J. L. McQuarrie, of Chicago, is applicable. His switching device is so arranged that if any key be depressed without the corresponding trunk plug being inserted in a jack, it will immediately restore itself to clear the ringing of all currents. If, however, the depression of a key follows the insertion of the plug, a magnetic lock becomes operative to hold the key. When the plug is removed from the jack, the key restores. It will be seen that with such means the effect of failure to depress a key is reduced from the false ringing of a station not desired to a mere temporary failure to ring. Further, the beginning of ringing by the toll operator before switching has been accomplished by the trunk operator is rendered of no effect.

TRANSMITTER.

Messrs. J. W. Lattig and C. L. Goodrum have jointly invented a transmitter having a two-cell chamber for the granular carbon. In the middle of the tubular chamber a carbon partition is placed. On either side of this the granular carbon is placed. Then the whole is sealed by the electrodes, these being flexibly mounted upon annuli of mica. At the front the granular button thus formed is supported by the diaphragm, while at the rear a stud projecting from the rear electrode engages the usual bridge piece. The Eastern Telephone Manufacturing Company has been assigned this patent.

STEP-BY-STEP SELECTIVE PRIVATE LINE SYSTEM.

An intercommunicating private line system worked out upon an automatic step-by-step basis forms the subject of a patent issued to J. J. A. Brown. The instruments are connected in series upon a one wire loop line which follows around the entire group of stations. The apparatus is arranged so that when the line is in use, no undesired stations can cut in and listen on or disturb the existing connection.

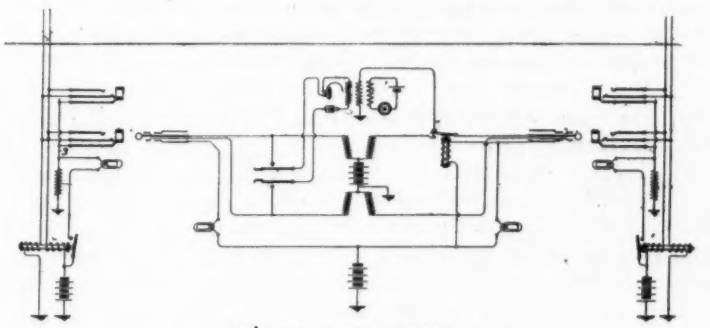
ANTISEPTIC MOUTHPIECE.

A new form of antiseptic mouthpiece has been patented by C. D. Wright, of Chicago. This is a metallic lining for the usual rubber mouthpiece, which is detachable and adapted to be carried in the pocket of the owner. An antiseptic gauze at its contracted end serves to protect the telephone user from any possible infection within the transmitter.

IMPROVEMENTS IN TWO-WIRE MULTIPLE SYSTEM.

Another patent granted to Messrs. Goodrum and Lattig, also assigned to the Eastern Telephone Manufacturing Company, relates to an improvement in their previously patented two-wire, common battery, multiple switchboard. In the earlier system the actuation of all signal relays depended upon reversals of the current therein. All were, therefore, polarized relays. The improved system abandons polarized relays as far as the cord circuit is concerned, and substitutes limit relays. These latter operate upon the currents flowing when a subscriber's receiver is off the hook, but fail to respond to the currents which flow when the receiver is on the hook. The proper working of the supervisory signals is entirely dependent upon the adjustment of these limit relays.

A second patent referring to a two-wire system is one granted to F. R. McBerty, of Evanston, Ill. This provides an improved arrangement of cord circuit for a special type of two-wire system. In this special type the signals are so wired that the tip of all plugs must be connected to the ungrounded pole of the battery, while



M'BERTY SWITCHBOARD.

the busy test demands that the plug tips be grounded. The reversal of conditions is accomplished by the insertion of a relay which automatically switches the plug tip from the ground to the battery upon the insertion of the plug in a spring jack. The patent, which refers to this feature, has been assigned to the Western Electric Company. A diagram of the circuits with the improvement embodied therein is shown in Fig. 1.

MISCELLANEOUS APPARATUS.

A rather odd "Telephone Attachment" has been patented by W. S. Haddock, of Uniontown, Pa. This attachment is a combined receiver support and transmitter damper. It consists of a stamping of sheet metal of a size to close the mouthpiece of a transmitter. It may be hung over the mouthpiece by means of a flange at its upper edge. From its lower edge extends a metal strip, which is formed into a clamp to take a receiver handle. If it is desired to leave the telephone and yet hold the line, the receiver carrying the attachment clamped to it is hung up on the transmitter, when the distant listener is shut out from any conversation which may take place.

Another recent patent describes a relay especially designed to reduce the "square" space required for it to a minimum. To this end the contact springs are mounted upon the tubular coil protector, so as to lie upon the diagonals of the "square" space and thus occupy the space which would otherwise be wasted. This relay is due to Messrs. F. R. McBerty, of Evanston, Ill., and H. M. Crane, of New York, their rights however being assigned to the Western Electric Company.

CURRENT NEWS AND NOTES.

TROLLEYS FOR BELFAST, IRELAND.—Mr. E. Harvey, United States Vice-Consul, Belfast, says: "At an early date a new system of street tramways will be inaugurated in this city. The present horse cars will be replaced by electric cars at a cost of over $4,000,000. There are now about 40 miles of rails in and about the city, and it is still a matter of controversy whether these rails will be heavy enough for the new traction, but as the system will be extended, 10 or 12 miles of new rails will be required in any case. The present cars will be discarded and replaced by 100 or more new electric cars. The tenders for these have not yet been published by the city corporation."

THE ALASKA CABLE.—Telegraphic communication has been reached between Seattle and all parts of Alaska. The following official message was received here announcing the opening of the line: "Sitka, Alaska, October 6, 1904.—To the Newspapers of Seattle and the Associated Press: The completion of the Government cable from Valdez to Sitka, making a complete connection by an all-American line with 46 stations in Alaska, is the beginning of a new era for Alaska. Wagon roads and railways will open up the greatest mining center of the world. Other industries will quickly follow and insure this country's future prosperity. WILLIAM L. DISTIN, Acting Governor of Alaska."

CHICAGO STREET CARS.—A special dispatch from Chicago of October 7 says: "Mayor Harrison to-day served notice upon the Chicago Union Traction Company to cease operating street cars in Adams, Desplaines, Harrison and Twelfth Streets and Western Avenue. According to Corporation Counsel Tolman, the Mayor's action is taken in view of efforts of the traction company to prevent a settlement of franchise disputes between the South Side surface lines and the city. The purpose of the Mayor, Mr. Tolman says, is to clear the way for a municipal street railway. At midnight Sunday the police will stop operation of cars on the streets named unless restrained by the courts in the meantime."

N. E. L. A. TRANSACTIONS.—Secretary Dudley Farrand says: "The proceedings of the twenty-seventh convention of the National Electric Light Association, recently held at Boston, are now nearly ready for distribution. As the proceedings cover about 1,300 pages, the book will be issued in two volumes. It has also been found necessary to use smaller type, owing to the bulk of the matter to be printed. These volumes are not only the most important in respect to size ever issued by the association, but the character of the papers, reports and discussions—and especially of the "Question Box" and "Wrinkles"—is proportionately valuable. As the book will be furnished only to members of the association, it will be worth the while of any central station not already a member to make application at once."

NEW YORK TELEPHONE RATES.—The Merchants' Association has begun an investigation of the telephone rates in New York and other cities, with a view to settling at rest once for all the complaint that the rates in New York are exorbitant, as compared with those charged in other cities. If they are found to be too high negotiations for their reduction will be opened with the New York Telephone Company, and if these fail it is said an appeal will be made to the Legislature to regulate telephone charges by law. A committee of about ten members of the association will be appointed to take charge of the investigation, the actual work of which will be done by telephone experts. U. N. Bethell, general manager of the New York Telephone Company, has promised to place all the facilities in his power at the service of the association.

THE TELEGRAPH IN MEXICO.—In his recent message to the Mexican Congress President Porfirio Diaz says: "With regard to the telegraph lines, I have to inform you that the newly strung lines of the Federal system aggregate 1,500 km. Nine new offices have been opened and a subterranean cable 1,500 meters long has been laid between the city of Campeche and the station of the Gulf submarine cable. The system of communication by wireless telegraph between Cape Haro, State of Sonora, and Santa Rosalia, Lower California, has continued to be operated with fair success. The earnings of the Federal telegraph lines as compared with the previous fiscal year have increased more than 10 per cent. and the service of drafts has been continued to be continually expanded to meet the public's demands, so that now nearly one-half of the 435 offices of the system have been authorized to provide the service in question."

TELEPHONES IN HOSPITALS.—In Philadelphia, it is stated, telephones are to remove the barrier between inmates of the Municipal Hospital and their friends in the outside world. Dr. Edward Martin, director of the Department of Public Health and Charities, has completed arrangements whereby a complete telephone system is to be installed in the Municipal Hospital, with telephones in each ward, so that direct communication between without and within may be had. Hitherto the hospital, entrance to which is forbidden to even the nearest relatives of patients, has been connected with the world by a single wire from a central exchange through the Electrical Bureau in City Hall. Communication was irregular and slow. With an exchange on each floor and in each ward it is believed that inquiries regarding the condition of patients can be answered speedily and satisfactorily both to patient and to friends.

TELEPHONY IN NEW YORK STATE.—It is noted from Albany that an interesting move in the struggle for the control of the telephone field in the northern section of the State is involved in an agreement entered into between the Hudson River Telephone Company and the Glen Telephone Company, whereby the former withdraws in the latter's favor from the local field in Fulton, Hamilton and Montgomery Counties. In return the Hudson River Company is to furnish exclusively all the long-distance service to the subscribers of the Glen Company. The Hudson River Company, who license under the Bell interests, claim that this is an important victory over the independent companies, since it practically shuts off their competitors from the field between Schenectady and Utica. By a similar agreement with the Central New York and Little Falls local companies the Hudson River Company has acquired exclusive control of the long-distance service in that vicinity.

SINGLE-PHASE COMMUTATOR MOTOR.—A patent recently issued to Mr. A. S. McAllister for improvements in alternating-current machinery relates to an interesting type of single-phase motor of the commutator type, which is designated as an induction-series machine. The field windings are similar to those of a two-phase induction motor, having, however, an unequal number of turns in the windings of the separate phases. Brushes are placed upon the commutator in mechanical line with the direction of polarization of the larger field coil. When the rotor is stationary the armature winding forms what is practically the primary of a static transformer. The axial brush-line field winding is the secondary of this transformer, while the remaining field winding, which is directly connected thereto, is an impedance load for the secondary of the transformer. There will flow in the primary (armature) a current in phase opposition to the secondary current, which produces magnetism in time-phase with itself, and in mechanical quadrature to the armature brush circuit. Since the armature current and the quadrature field magnetism reverse signs together, the torque due to their product will remain always of the same sign. Hence, the machine operates similarly to a direct-current motor. Under speed conditions a counter e.m.f. is generated at the commutator brushes in time-phase with the quadrature field magnetism and hence in phase opposition with the armature current, so that with increase of speed the armature current comes more and more into phase with the e.m.f. and the power factor continually increases. A second patent relates to certain modifications of the above construction. By employing a second set of brushes placed in mechanical quadrature to the main primary set and connecting the former brushes with the secondary (field) coil, the quadrature field coil may be dispensed with and the armature circuit used for this purpose. This modification leads to increased power factor during operation. An additional modification leads to a two-phase series motor, which consists of a two-phase stator winding and a direct-current armature as rotor winding, two sets of brushes being used. The currents in the two component motors need not be in phase quadrature, but may be of the same phase, so that the machine is operative from a single-phase circuit when insulating transformers are used.

LETTER TO THE EDITORS.

Electrolytic Corrosion.

To the Editors of Electrical World and Engineer:

SIRS:—The interesting letter of Mr. Mansfield, printed in your issue of last week, recalls similar singular cases of corrosion which were noted when the overhead trolley system was employed in the Baltimore & Ohio tunnels at Baltimore. Much trouble was experienced with trolley hangers, and it was found that in those which failed the bolts embedded in the insulation were much corroded, in some cases the diameter at places being reduced a sixteenth inch or more. In view of the fact that the corrosion occurred at surfaces hermetically sealed by the insulation, it would appear that, at least initially, the electrolysis—assuming this to be the cause—was of a nature differing from the accepted process involving the presence of moisture.

BALTIMORE, MD. JAMES L. HYDE.

DIGEST OF CURRENT ELECTRICAL LITERATURE.

DYNAMOS, MOTORS AND TRANSFORMERS.

Auto-transformer.—SLOVSA.—The conclusion of his article on the theory of the auto-transformer. He gives an analytical calculation with the use of Steinmetz's symbolic method and discusses the special case in which the load consists of incandescent lamps. He then compares the auto-transformer with the ordinary transformer and shows that in the former the copper losses and the iron losses are smaller under the same conditions of operation. In the auto-transformer the efficiency is a maximum if the heat loss in copper is $1 - 1/n^2$ times the heat loss in iron, where n is the ratio of transformation (ratio of number of primary or total turns to number of secondary turns). For a given capacity, the auto-transformer requires a much smaller quantity of active copper and iron. The no-load current is smaller and the efficiency higher, while the voltage drop is of less importance than in the case of the ordinary transformer. The auto-transformer has, however, the disadvantage that the high-tension circuit is not electrically separated from the low-tension circuit, which represents a source of danger. He thinks it could be used to advantage whenever high tension is to be transformed into a still higher tension or in such cases where simple variable ratios of transformation are required.—*Zeit. f. Elek.* (Vienna), September 25.

REFERENCES.

Three-Wire Generator.—An illustrated article on the direct-current dynamo, giving the full over-all voltage at the brushes and having the third terminal connected to the neutral of the three-wire system. This third terminal is connected to the middle point of an auto-transformer or balancing coil, the terminals of which are connected to points of opposite potential of the armature winding in the generator. The elementary properties of the auto-transformer are considered.—*Amer. Elec.*, September.

Commutation.—NEILD AND BANTING.—A paper, illustrated by diagrams, read before the Rugby Engineering Society. The authors give, without mathematics, the general principles of commutation of direct-current generators and motors. They deal with the effects of weakening the field and discuss the reactance voltage. They briefly deal with the special case of crane motors and mention some errors of construction.—Lond. *Elec. Eng.*, September 23.

Excitation and Compounding of Alternators.—KUEPPERS.—An illustrated description of various methods in which the continuous current for excitation is obtained from the alternator itself by means of some auxiliary converting device and in which simultaneously the voltage at the terminals of the alternator is maintained constant.—*Elek. Rundschau*, September 15.

Single-Phase Series Motors.—REYVAL.—A summary of recent papers on this subject by Steinmetz, Lamme, Finzi, Latour, Eichberg and Winter.—*L'Eclairage Elec.*, September 24.

Starting Single-Phase Motors.—BOYD.—An illustrated article on the starting of the Heyland single-phase induction motor, which has two windings on the stator, a running winding and an auxiliary winding. These are in parallel at the start, and the auxiliary winding is cut out when the motor has attained a speed sufficient to enable it to run as a single-phase motor. The running or main winding is inserted in slots in the ordinary way, but the auxiliary winding passes through rectangular holes and is displaced 90 electrical degrees from the main winding. The author describes experiments made to show the distribution of the flux in the air-gap before and after the rotor circuits are closed, and to explain how the latter distribution is brought about so that a torque is produced in a definite direction. The article is illustrated by various diagrams.—Lond. *Elec.*, September 23.

Testing Induction Motors.—A brief editorial note on the article by Alexanderson in a recent issue of ELECTRICAL WORLD AND ENGINEER. The method is said to be ingenious, but limited to those cases only where a motor is to be tested for output roughly and quickly. The reason is that the method is based on a number of assumptions which are not strictly correct. Moreover, the testing equipment is not so much simpler than that necessitated by other methods as to constitute any real advantage in this respect.—Lond. *Elec.*, September 16.

Testing Electrical Machinery.—WORKMAN.—A continuation of his serial on factory testing of electrical machinery. He describes how to take speed curves of series motors and deals at some length with temperature tests. He finally discusses the special test of the field form from measurement of e.m.f. between commutator bars, in order to ascertain the effect to armature reaction in distorting the field; to find the width of the fringe at the tips of the poles, and to find the maximum difference of potential between commutator bars.—*Elec. Club Jour.*, September.

Alternating-Current Diagrams.—KARAPETOFF.—A continuation of his serial on applications of alternating-current diagrams. In this installment he deals with alternating-current generators and discusses the equivalent total current and resistance of two-phase and three-phase machines.—*Elec. Club Jour.*, September.

LIGHTS AND LIGHTING.

Manufacture of the Osmium Lamp Abandoned.—A note stating that on August 1 the osmium lamp department of the Auer Incandescent Gas Light Company, in Vienna, ceased operation. "The endeavors to make the lamp practically useful and to make it a commercial success have been abandoned, since the technical difficulties of the osmium lamp could not be overcome."—*Elek. Rundschau*, September 1.

Arc Lamp with Hot-Wire Control.—An illustrated description of the latest form of the Foster arc lamp, the distinctive feature of which is the hot-wire control in place of the ordinary solenoid control, thus enabling the same lamp to be used either on alternating or continuous-current circuits. The construction of the lamp is described in detail and illustrated. In an editorial note it is said that one of the chief difficulties hitherto found in the use of hot-wire control has been due to the fact that there is a considerable time lag between a decrease of the current and the cooling of the hot wire, with the result that the arc constantly gets too long and the lamp does not feed with sufficient rapidity until the arc is extinguished. This is said to be avoided in the present type, by employing a higher temperature for the hot wire than hitherto, the cooling, of course, being more rapid at the upper part of the temperature curve. A novel feature is also the strut device which controls the motion of the bottom end of the hot strip.—Lond. *Elec.*, September 16.

POWER.

High-Tension, Direct-Current System.—TILNEY.—An illustrated article on the Twickenham and Teddington electricity undertaking. There are at Twickenham two steam-driven 200-kw generators, field excitation being obtained from the low-tension bus-bars at 480 volts.

The armature cores are smooth, the conductors being form wound and very carefully insulated. Hard-drawn copper bars are employed for the commutators, which are built up in the usual way with mica insulation, but the inside is left rough with all the mica sheets projecting considerably beyond the bars, as it has been found that machining the inside of the commutators, even roughly, increases the risk of short-circuits by tending to carry a skin of copper over the mica insulation. A shield of mica, about one inch high, projects above the commutator, between the bar and the sleeve that carries them, and in each of the machines for Twickenham there are 549 bars on the commutator, giving between 19 and 20 volts per bar. The brushes are of the "galvanic type." High-tension currents are transmitted to three sub-stations by means of concentric cables made for a working pressure of about 2,600 volts between conductors, the outer conductor being earthed. Two of the sub-stations will not have attendants, the "transformers" being started up on the high-tension side from the generating station and switched in on the low-tension side also from the generating station by means of long-range switches fixed in the sub-stations. The construction of the "transformers" is described as follows: "The windings, both high and low-tension, are put on to the same core, in both cases being wound on 'formers.' The low-tension windings are put on first, and the high-tension are put on over them, great care being taken to see that the two sets are absolutely insulated from one another. In the larger sizes of four-pole machines steel clamps are forced on over the ends of the low-tension winding and the high-tension windings are put on over these clamps and another clamp is put on over each end of the high-tension windings. * * * When the machine is supplying low-tension side current its fields are excited from the low-tension armature, but there is a small winding in series with the high-tension armature windings which provides the necessary excitation for starting up, and this winding is automatically short-circuited when the voltage on the low-tension side reaches a predetermined figure, such as 300 volts, by means of a small switch with carbon breaking points, which is worked by a solenoid in series with the low-tension shunt windings." In connection with this plant it is mentioned that Edmundson's Electricity Corporation has made most extended use of the high-tension, continuous-current system, having put down a plant at Guernsey where a pressure of about 2,600 volts is used for transmitting power to outlying parts of the island, as well as at other places, among them Newport, for supply to Cowes. In the latter case the ultimate use of 5,000 volts on a three-wire system is proposed.—Lond. *Elec.*, September 16.

Single-Phase Currents in Electric Power Transmission.—BULLARD AND SPROUT.—A Pacific Coast Electric Transmission Association paper on possibilities of single-phase currents in electric power transmission. The authors point out the advantages of single-phase over three-phase, and show that of the different arrangements of single-phase those with one overhead wire would be the cheapest. The return circuit may then be obtained either by another wire, not strung on the poles, but buried in the ground in any convenient location along the right of way; or a ground return may be obtained by sinking more or less deep shafts in the nature of artesian wells at all generating and sub-stations, thereby obtaining the necessary ground return. The feature of the grounded return would not increase the cost of insulators, since the ideal condition is obtained, namely, a single insulator on the top of a single long pin, the pole. Nor would it increase the cost of insulating the main step-up and the main step-down transformers, since this very ground would be their protection by eliminating all sources of insulation breakdown. All static accumulations on the line would be done away with, and the effects of capacity, reactance, inductance, etc., would seem to be neutralized or utilized, as the case may be, and to an extent eliminating many of the present troubles on three-phase lines.—*Jour. Elec. Power & Gas,* July.

Italian Power Transmission.—An illustrated article on an electric power transmission in the Lombardia. The Serio River was found to be capable of developing 4,000 hp, 2,000 at Gromo and another 2,000 at a point higher up the stream. Only the 2,000 hp at Gromo have thus far been utilized. Three-phase currents are transmitted at 40,000 volts to Nembro, a small town 21 miles distant, where spinning mills are driven electrically. The equipment of the power house and of the transmisison line are described.—Lond. *Elec. Rev.*, September 23.

Transmission of Power Versus Shipment of Fuel.—BOWIE.—A Pacific Coast Electrical Transmission Association paper in which the author gives the results of calculations made by him in a certain case in which it was intended to erect a plant of 9,000 kw capacity in the oil fields and to transmit the power to a center of distribution 150 miles distant at a voltage of transmission of 60,000. The main result is that in this case the cost of transmitting power would be sufficient to offset an additional price for freight per barrel of oil between the power house and the center of distribution of from 26 to 33 cents. The latter condition would be the safer one on which to figure. Hence, with freight at 33 cents per barrel it would pay equally well to install the plant at the center of distribution and to ship oil thereto. Under such conditions it would certainly be preferable to put a plant at the latter point to avoid possibilities of a long line getting out of order, and to obtain better service. With a much larger plant and a higher voltage, however, conditions might be easily changed.—*Jour. Elec. Power & Gas,* July.

Electric Driving.—GUARANI.—An illustrated article on electric driving at the Witton Works of the British General Electric Company, at Witton, near Birmingham. Direct current is used. With the exception of the large machine tools, which have their own motors, the machines in the workshops are operated by a main driving shaft of 300 ft. length which is divided into three sections, each of which has its own motor.—*American Machinist,* October 6.

Compound Engines.—HAYWARD.—A British Association paper, illustrated by diagrams, on the effects of receiver drop in a compound engine. The author deals with the results of four experiments made to demonstrate the effects of varying the points of cut-off in the low-pressure cylinder of a compound engine, other conditions being maintained constant.—Lond. *Elec.*, September 16.

Steam Turbines.—An illustrated article by Lasche on steam turbine construction in the shops of the Union Electric Company, of Berlin, and an illustrated translation in abstract of a paper by Riedler on the Riedler-Stumpf turbine and its application.—*Power,* October.

TRACTION.

Traction in Switzerland.—TISSOT.—A discussion of the problem of substituting electric traction for steam traction on railroads of Switzerland. The various advantages of electric traction and the difficulties of its introduction are discussed. It is mentioned that the consumption of coal by the railroads of Switzerland in 1901 was 446,000 tons, which represents an expense of $2,800,000. It is stated that an electric plant in the Canton of Schwytz, by selling electrical energy at 0.4 cent per kw-hour, expects to pay a sufficient dividend, even if charging 10 per cent. for interest and amortization.—*L'Industrie Elec.,* August 25.

Third Rail.—An editorial on the status of the third-rail system. The New York, New Haven & Hartford Company recently discontinued electric operation on the Nantasket branch division, and the reasons are explained. The third rail is very satisfactory under certain conditions, but it cannot perform miracles. As installed at Nantasket, it was in the center of the track, which is not a desirable position. It is considered to constitute a special device in electrical traction rather than a general method.—*St. R'y Jour.*, October 1.

REFERENCE.

Railway Motor Field Coils.—An illustrated note on the construction of indestructible railway motor field coils, describing the process of manufacture of asbestos-insulated strap-wound coils.—*Elec. Club Jour.*, September.

INSTALLATIONS, SYSTEMS AND APPLIANCES.

Charging for Electrical Energy.—HUNT.—A Pacific Coast Transmission Association paper on a proposed method of determining meter rates for the sale of current, with an example from data of a large steam-driven plant. The gist of his system is as follows: Each consumer, regardless of the size of his installation, should pay an equal share of the total distribution production cost and of the total general expense, less interest, depreciation, taxes and insurance. Each kilowatt capacity connected should pay an equal portion of the total manufacturing stand-by cost, of the total interest and depreciation charge, plus taxes and insurance, and of the total distribution stand-by cost. Each kilowatt-hour sold should bear a charge equal to the total manufacturing production cost divided by the number of kilowatt-hours sold. The rate so determined should be modified by arbitrarily assuming an upper and lower limit beyond which the rate shall not go. The upper limit will usually be determined by the maximum allowed by municipal or

other regulation. The lower limit should be placed at a point to compete with the cost of production in isolated plants, or other competing sources. The two limits may, for instance, be taken as 10 cents and 3 cents per kw-hour. The paper is illustrated by various diagrams and the author thinks it is not difficult to use the system in practice. For the miscellaneous business of retail supply in cities and towns he thinks it would be useful.—*Jour. Elec. Power & Gas*, July.

WIRES, WIRING AND CONDUITS.

Temperature Coefficient of Copper Conductors.—An editorial note on a special point in the tables of standards of copper conductors, issued by the British English Standards Committee. It is there said that the average temperature coefficient of 0.00238 per degree F. (0.00428 per degree C.) is adopted for commercial purposes. This is criticized to be misleading, since the resistance at different temperatures, t in degree F., should be deduced from the formula $Rt = R_{32}\ [1 + 0.002386\ (t - 32)]$. While the average temperature coefficient between 32° and 42° F. is 0.002374, it is 0.002402 between 72° and 82°, and it is 0.002416 between 92° and 102°.—Lond. *Elec. Rev.*, September 23.

ELECTRO-PHYSICS AND MAGNETISM.

Energy of Radioactivity.—BREYDEL.—An article discussing the question as to the source of the energy of radioactivity. He compares the transformation of radium into helium with the transformation of ozone into oxygen. He considers radium to be in an unstable condition and the energy of radioactivity to be due to the transformation which radium undergoes during the radiation and volatilization in order to assume the stable form of helium.—*L'Eclairage Elec.*, September 24.

REFERENCES.

Magnetic Reluctance of Air Cores in Short Coils.—THORNTON.—Air core transformers and induction coils, as used in testing rooms or laboratory practice, have definite magnetic constants. The reluctance of the circuit taken by the lines remains the same under all conditions of excitation. The author has made experiments to determine the constants for coils of given proportions, the thickness and length of the windings of which place them beyond the reach of ordinary mathematics. The results are given in diagrams and tables, and among other things the author shows that the impedance of coils whose length exceeds their diameter, is strictly proportional to the length. The author finally gives some simple formulas for calculating the inductance of coils.—Lond. *Elec.*, September 16.

Magnetic Properties of Alkaline Metals.—BERNINI.—An account of an investigation in which he found that sodium, potassium and lithium are feebly paramagnetic.—*Nuovo Cimento*, June; abstracted in Lond. *Elec.*, September 16.

Electronic Theory.—ABRAHAM.—A British Association mathematical paper on the reaction of the radiation on a moving electron.—Lond. *Elec.*, September 16.

ELECTRO-CHEMISTRY AND BATTERIES.

Electrolytic Iron.—SKRABAL.—An account of experiments on electrolytic refining of iron. There are two essentially different methods by which two different kinds of electrolytic iron are obtained. The first method is to use a ferrous salt as electrolyte, iron as anode and low voltage and a low current density. By this method very compact and extremely hard iron of silver-white color is obtained. In the second method platinum is used as anode with a high voltage and a high current density, while the electrolyte contains bivalent iron in any complex form. The iron thus obtained is of more grayish color, is less compact and less hard. The author discusses especially the first method.—*Zeit. f. Elektrochemie*, September 23.

Electrolysis of Zinc Chloride Dissolved in Acetone.—PATTEN.—An account of experiments on the deposition of zinc chloride dissolved in acetone. He used polished platinum electrodes 0.7 cm. apart and 3 cm.² in area. The decomposition point is about 2 volts. Chloroform, chloracetone or other alkyl chlorides are formed at the anode and a compact smooth coating of zinc is deposited upon the cathode.—*Jour. Phys. Chem.*, October.

UNITS, MEASUREMENTS AND INSTRUMENTS.

Plotting Alternating-Current Curves.—MÜLLER.—An illustrated article on the use of the oscillograph for plotting alternating-current curves. The essential arrangement of the apparatus is shown in Fig. 1. A single loop of very thin and hard-drawn silver wire, 0.1 mm. in diameter, is placed between the parallel pole shoes of a strong electromagnet. s is a very thin glass mirror, mounted on a piece of cork. If a current passes through the loop, the two sides of the loop are moved in opposite directions, perpendicular to the direction of the magnetic field. If an alternating current passes through the loop, the deviations are in any moment proportional to the instantaneous values of the current. If the period of oscillations of the loop is very small, compared with the period of the alternating current, and if the damping of the loop is great, it is possible to plot the alternating-current curves by directing a ray of light on to the mirror, s. If the silver wire is 0.1 mm. thick and tightly stretched, the current must be about 0.2 to 0.5 amp. in a strong magnetic field of 5,000 c.g.s. units, to render the deviation of the mirror sufficiently large. The author gives some further details of the construction of his apparatus and remarks that he now uses, instead of a single silver wire loop, a small coil of 12 windings of copper wire of 0.1 mm. diameter. The construction of this coil is described.—*Elek. Rundschau*, September 15.

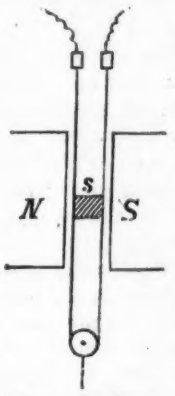


FIG. 1.—OSCILLOGRAPH.

Dynamometer for Rapid Oscillations.—PAPALEXI.—A description of a dynamometer for rapid electric oscillations based upon induction instead of electrodynamic attraction. The needle of the instrument carries a wooden cross with squares of aluminum strips at the four ends, all lying in the same plane. The center is attached to a thin wire bearing a mirror for reading the reflection and a piece of mica for damping. The wire, again, is attached to two cocoon fibres 32 cm. long and the needle hangs between two sets of four small coils which can be used differentially. The sensitiveness may be varied by varying the distance between the two sets of coils. In the zero position the aluminum squares are not directly above the coils. The author tested the instrument by means of oscillations of a frequency of 7,000,000 per second and found a good agreement with the indications of a bolometer used at the same time. It had the advantage of not requiring a supersensitive galvanometer.—*Ann. d. Physik.*, No. 9; abstracted in Lond. *Elec.*, September 16.

REFERENCE.

Power Factor Meter.—MACGAHAN.—A long illustrated article describing the construction and connections of power factor meters and discussing, with the aid of diagrams, the method of their working.—*Elec. Club Jour.*, September.

TELEGRAPHY, TELEPHONY AND SIGNALS.

Submarine Telephone Cables.—An editorial discussing the recent article of Breisig which was abstracted at length in the Digest, and in which some new types of submarine telephone cables were described, the most important properties of which are paper insulation under lead and the covering of the copper conductor with a closed helix of fine iron wire in order to increase the self-induction. The editorial writer doubts whether the advantages gained are sufficient to outweigh the disadvantage of increasing the diameter of the core and thereby increasing the capacity, weight and cost of the cable. The writer suggests the employment of a single conductor instead of a metallic circuit in the submarine section of a long telephone cable. "It should be possible after some preliminary experimental work to design a cable in which the conductor was first surrounded with a layer of paper, then with gutta-percha, and finally with the usual protection and armoring. The paper layer would diminish the capacity enormously, and it should not be impossible to place the gutta-percha around the paper-covered conductor in such a way as to render it water-proof. By bringing the earth connections sufficiently far out to sea, and employing at each end between the cable and the metallic circuit land line an induction coil, or "translator," resembling those formerly employed for connecting together metallic circuit and single-wire subscribers on "mixed-circuit" telephone exchanges, the difficulty of disturbance by outside induction effects might be avoided."—Lond. *Elec.*, September 2. In a reply to this criticism, Breisig points out that neither the weights nor the cost of the new cables described by him exceed to an extraordinary degree the weight and cost of cables of the old type, while the new ones are much better in other electrical properties; i. e., the

increased capacity was more than balanced by the increased inductance, since the damping per unit length of these new cables is considerably lower than that of any cable hitherto manufactured. He says that this beneficial effect is only available on heavy conductors with great copper section and low resistance. A damping constant of 0.006 per km. is near the limit which can be attained by such methods. He criticises adversely the suggestion of a single conductor cable. In experiments made with such cables he found that such a cable must show at high frequencies an elevated resistance and diminished self-induction, with resulting poor transmission. It must be the losses by eddy currents generated in the armoring wires which caused this effect. It is impossible to eliminate this effect in a single-core cable.—Lond. *Elec.*, September 16.

Tuned Wireless Telegraphy Transmitters.—SLABY.—A second paper on this subject. In the first paper, which was recently abstracted in the Digest, he had shown that the wave length of a given Marconi transmitter can be increased without varying the length of the vertical wire. The means for this purpose are to insert coils or to apply at the end of the wire capacities in form of metallic surfaces or horizontally extended wires. It is more difficult to shorten the wave length. This can only be done by condensers inserted in the vertical wire. The author first discusses the question whether the values of capacity which are found by the telephone bridge method, i. e., for slow oscillations, are also valid for the rapid oscillations of wireless telegraphy. The author describes experiments made first with air condensers, secondly with Leyden jars and thirdly with Grisson condensers, consisting of iron sheets embedded in a mixture of wax, paraffin and resin. He found that air condensers have the same capacity for rapid oscillations as for slow oscillations. Glass condensers (Leyden jars) behave in a different way according to their construction; they may have the same capacity for quick as for slow oscillations, or the ratio of the capacities for quick and slow oscillations may be smaller than unity, varying between 1 and 0.9. He calls this ratio the reduction factor. Grisson condensers have a reduction factor which depends on the frequency. He found the following empirical formula for the reduction factor: it equals the half wave length in meters divided by the sum of the half wave length and 8.56. The author then discusses the transmitter in which the vertical wire of the length is connected to one plate of a condenser, while the other plate is connected through an air-gap to earth, as shown in Fig. 2.

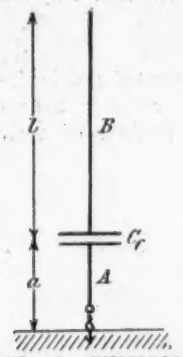


FIG. 2.—WIRELESS TELEGRAPH TRANSMITTER.

If the second plate of the condenser is connected not directly to the one pole of the air-gap, but by a length of wire, *a*, the conditions are rather complicated, since three different waves are formed, the lengths of which depend on *l*, *a* and *Cf*. The situation is much simplified if $a = 0$; that is, if the one condenser plate is connected directly with the earthed air-gap. In this case only one strong wire wave is obtained in *B*. He shows that the conditions in this case can be easily calculated and that the calculated results agree with the results of the measurements. He finally discusses that type of transmitter in which indirect excitation is used by means of a Tesla transformer, the primary winding of which is supplied with high-frequency current. Such a transmitter can never be tuned to a single wave length, since always two waves are obtained. He considers this type of transmitter as an inferior one.—*Elek. Zeit.*, September 8.

Duplex Balancing of Telegraph Cables.—GAYE.—The first part of an illustrated article on the balancing of cables for the purpose of duplex telegraphy. The author first makes some general remarks and then discusses the case in which two cables are balanced one against the other, on the resistance bridge principle, as shown in Fig. 3. In order that the instrument through which the beginning of the one is connected with that of the other may not be affected after the depression of the key, arrangement is to be made so that the potential values at these points shall be at all times equal. He shows that to effect a perfect balance it is necessary to observe two conditions. First, that the resistance before the cable and artificial line are directly proportional to the square root of their respective core ratios. Second, that they are also in direct proportion to the total resistances of the cable and artificial line beyond them. In submarine telegraphy the first condition is of higher significance, while with overhead land lines the second condition requires to be more closely complied with. However, in practice, even though these two conditions may have been conformed to, yet it is invariably found that the potential at the beginning of the artificial line will not commence its rise as quickly as that at the beginning of the cable. To quicken the rise on that side of the instrument, it is a general practice to

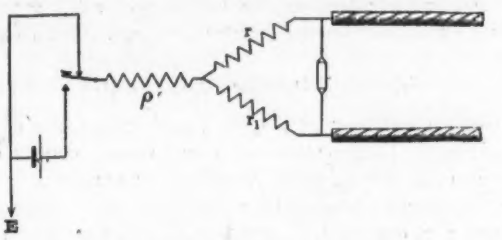


FIG. 3.—DUPLEX BALANCER AND CABLES.

insert a resistance (customarily of the order of tens of ohms) either before the beginning of the line or—what has the same effect—between its "sheathing" side and the earth. Since this hastening of the rise on the artificial line side is found thus necessary, the desired result may be equally well achieved by correspondingly delaying that on the cable side of the instrument. This may be done by connection of a condenser of small capacity in parallel with the beginning of the cable. It is, however, questionable whether a better approximation to a perfect balance would not be obtained if, instead of the adoption of either of these expedients, a small amount of inductance were incorporated into the beginning of the artificial lines.—Lond. *Elec.*, September 23.

MISCELLANEOUS.

Electricity in the Fire Brigade.—An illustrated description of a steam fire engine with certain electrical equipments intended to facilitate the work of the firemen and to maintain communication between them and the officer in charge. Helmets fitted with telephones and air draft arrangement are provided for the firemen; there is also provided an electric lighting circuit supplying current to protected incandescent lamps which the men carry.—Lond. *Elec.*, September 16.

Sprague-General Electric Automatic Relay Train Control for Boston Elevated Railway.

BY G. H. HILL.

THE Boston Elevated Railway has recently installed on 24 cars the Sprague-General Electric system of automatic relay train control, which embodies some novel and interesting features.

This control employs magnetic switches or contactors of the standard General Electric type for producing the motor circuit combinations. The action of these contactors is controlled from the master controller, operated by the motorman, but governed automatically by a current relay or "throttle" connected in the motor circuit so that the accelerating current of the motors is substantially constant. This is accomplished by having small auxiliary interlocking contacts on certain of the contactors so arranged and connected that the contactors will be always energized in a definite succession. Starting with the motors in series with all resistance in circuit, the resistance is cut out step by step, then the motors are connected in parallel with all resistance in, and the resistance again cut out step by step. This succession is always followed whether the master controller is turned on slowly or thrown directly to the full "on" position. The progression can be arrested at any point, however, by the master controller, and never goes beyond the point indicated by the position of the master controller handle. The rate of the progression is absolutely governed by a throttle relay (Fig. 2, upper part), so that the advance is not made faster than will keep the current in the motors within the prescribed limit.

One of these throttle relays is provided with each car equipment so that while the contactors on all cars of a train are controlled from the master controller at the head of the train as to the application and removal of power, the rate of progression through the successive steps is limited by the relays on each car independently, according to the adjustment and current requirements of that particular car.

A particularly noteworthy feature of the control is the method of accomplishing the series-parallel connection of the motors. This is by the so-called "bridge" method of connections, which are arranged so that the circuit through the motors is not opened during

the transition from series to parallel, and so that the full torque of both motors is preserved a all times from the series to the full parallel connection. The result is a perfectly smooth acceleration and entire absence of the jerk noticeable in ordinary series-parallel controls when passing from series to parallel, especially with as large motors as are used on modern elevated cars.

The circuit combinations of the motors are shown on the accompanying diagram, Fig. 1, which illustrates clearly the manner in which the above result is accomplished. The connections are the same as usual, with separate resistances for each motor, up to the position "Full Series A." The next combination places a bridge connection between the motors, inside of the resistances, and opens the shunts around the resistances, as in "Full Series B." The next step ("Parallel 1st Point A") makes a ground connection on No. 1 motor and trolley connection on No. 2 motor resistances, which places each motor across line potential with resistance in each circuit, giving parallel connection—the bridge connection becoming an equalizer between points of substantially equal potential. This bridge connection is

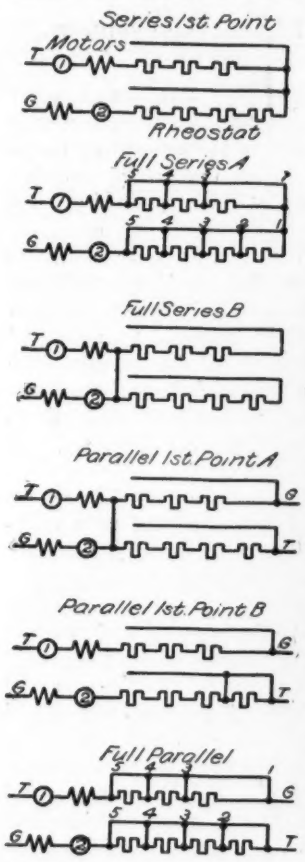


FIG. 1.—CIRCUIT COMBINATIONS.

FIG. 2.—TRIPLE MAGNETS, THROTTLE RELAY.

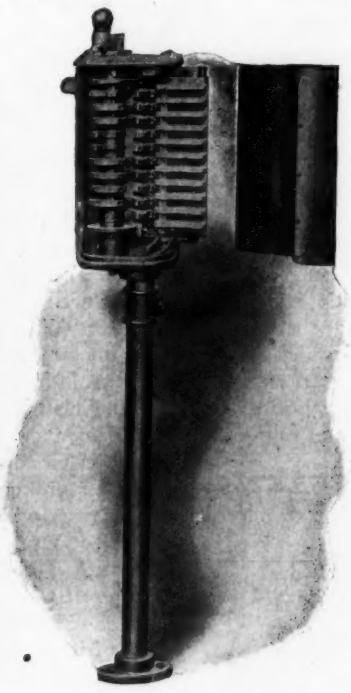
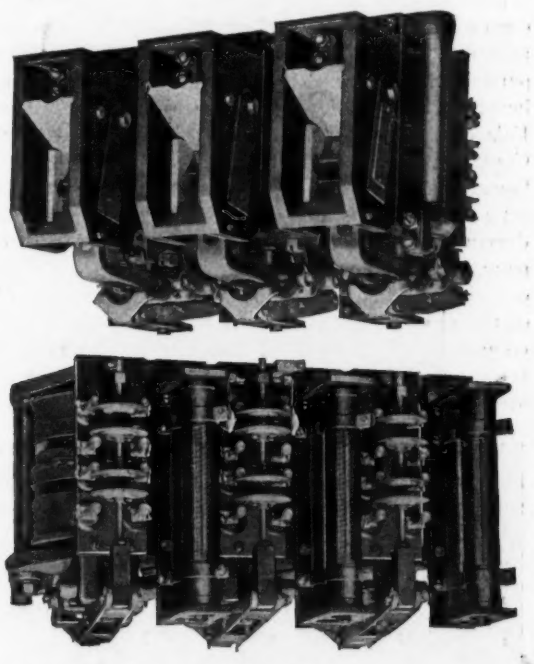


FIG. 3.—MASTER CONTROLLER.



FIGS. 4 AND 5.—CONTACTOR UNITS AND INTERLOCKING CONTACTS.

When the master controller is moved to its second position, a circuit is completed through the accelerating wire (No. 1), (see Fig. 2), in addition to the above circuits, which energizes the contactor shunting the first resistance step, the current also passing through the fine wire coil and the contacts of the throttle relay. The plunger of this relay has a lost motion, so that an appreciable time is required to move it, and this time is adjusted to be the same as that required by the contactor in closing its contact. These two devices thus operate simultaneously. The contactor, being lifted, shifts its operating coil, by means of the auxiliary contacts carried on its stem, into the circuit through the series contactor above mentioned, which maintains it in the closed position independent of the circuit that has lifted it. At the same time the throttle relay has opened the lifting or accelerating circuit. The shunting of the resistance step by the contactor causes an increased current to flow through the motor circuit and through the heavy coil of the throttle relay, which is sufficient to hold the relay plunger in its raised position, and so keeps the accelerating circuit open until the motors by speeding up cause the current to diminish enough to allow the relay plunger to drop. Circuit is then established through the contactors shunting the second resistance step (the first contactor having shifted this circuit also), and these contactors are energized and the relay again lifted and held up by the increased current, and so on until all the resistance is cut out.

When the master controller is moved to the third position, the parallel circuit is established, and the bridge contactor and then the parallel contactors closed and the motors connected in the multiple arrangement. When the master controller is moved to its fourth or "full-on" position, the resistance is cut out step-by-step as in series. These same successive actions are produced if the master controller is thrown to the full on position directly, as the interlocking contacts prevent an advance circuit being established before the proper preliminary action has taken place.

If at any point during the acceleration the master controller is moved to its "lap" position, the existing positions of the contactors are maintained, but the further progression is arrested so that the motorman can limit the acceleration to as slow a rate as desired, but he cannot exceed the rate for which the relay is adjusted.

The sixth wire in the train line above referred to, providing an emergency cut-off, is connected to a switch in the motorman's cab and to trip magnets on the top of the cut-out switches (Fig. 1, lower part) provided on each car of the train. All of the control circuits for each car pass through its individual cut-out switch and when the motorman operates the emergency switch in his cab all of the cut-out switches on the train are opened, thus cutting off power on all of the cars.

The master controller, Fig. 3, consists of a single cylinder with handle directly connected thereto. The handle is moved in one direction to give forward movement of the car and has four positions in this direction, corresponding to: 1st, switching position in series, giving a slow movement; 2d, accelerating position series; 3d, lap position in parallel, and 4th, accelerating position parallel. There are but two positions in the reverse direction corresponding to the two first mentioned for forward. The handle is returned to the central or "off" position by a spring so that the power is cut off whenever the motorman releases the handle.

There are five circuits leading from the master controller and five corresponding train wires for this control proper. There is also a sixth circuit in the train line which is used for an emergency cut-off (Fig. 1, lower part), to be described later. The five circuits comprise one for forward direction, one for reverse, one each for series and parallel, and the fifth for controlling the acceleration.

When the master controller is moved to its first position (say forward), the forward direction wire is energized, which throws the reverser to its forward position, and when so thrown energizes contactors in the main or trolley leads to the motors. At the same time the series contactor is energized and the circuit through the motors is completed in series, with all resistance in circuit, giving a slow speed forward. In this position no further action is produced.

A further automatic protection is provided by a cut-off relay. This relay has its coil connected to the lead from the collecting shoes of the respective car, and its contacts are so connected in the contactor circuits that in case of failure of power to the car, such as would be caused by passing over a dead section of rail, this relay is de-energized and causes the control circuits on that car to be thrown back to series position with resistance in, and when power is restored the control progresses automatically step by step to its former advanced position. This prevents any surging or overloading on such occasions.

The master controller, illustrated in Fig. 3, is of small dimensions and occupies but very little space in the cab. One of the contactor units with interlocking contacts is shown in Figs. 4 and 5.

The cars weigh approximately 35 tons each and are equipped with two General Electric 68 motors geared to a maximum speed of about 40 miles per hour. The acceleration is adjusted to approximately 1½ miles per hour per second.

Russian Pavilion in the Palace of Transportation, St. Louis.

Russia's only building at the Louisiana Purchase Exposition, the center of much interest in the Palace of Transportation, excites only regret that the withdrawal of the Czar's Government from formal participation in the Fair has deprived it of larger and more comprehensive displays of the same attractive type. The pavilion in the Palace of Transportation, which was erected by the Westinghouse Company, Limited, of St. Petersburg, as a feature of the Westinghouse brake exhibits, is representative in every feature of Russian art and workmanship, and is recognized as the general Russian rendezvous at St. Louis. In the Palace of Machinery the same company, which has made every effort to insure a characteristic Russian exhibit at the Fair, has furnished a small Russian kiosk at the head of the row of national booths erected by the different Westinghouse companies of Europe and America, and at both places, as a manifestation of Russian hospitality, Russian tea, brewed in curious old samovars, and suchari, a sweet native biscuit, are served to visitors

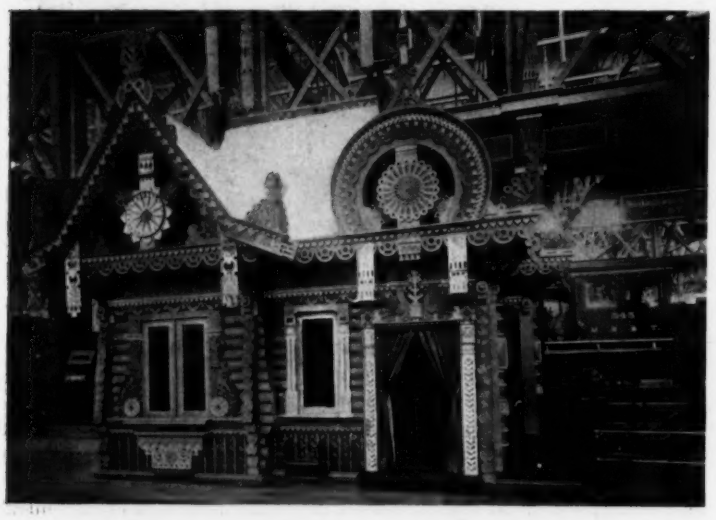


EXHIBIT OF ST. PETERSBURG WESTINGHOUSE COMPANY.

of the company by Russian girls wearing richly embroidered boyarin costumes.

The pavilion in the Palace of Transportation covers a space 20 by 25 ft. and is 25 ft. high. It was constructed by peasant builders in the Possade Sergiewo, near Moscow, after designs by the native architect Baranowsky, who has done much important work in St. Petersburg. Although buildings of a similar character are still built to-day in the interior of Russia, on a less elaborate plan, for small homes and pavilions, the style of construction is quite primitive, the exterior being that of a forest log cabin. The logs are neatly hewn, however, and notched together so closely that no open joints remain to be plastered, as in American huts. The rafters of the high roof, also, are mortised into the plate, and no nails whatever are necessary in the construction—the entire building having been shipped to this country in boxes. The fantastic taste of the peasants is indicated in the curiously sawn eaves, gables and cornices, which are elaborately ornamented and painted in the gayest colors. The material used throughout is a white pine from the forests around Moscow, very effectively stained in the case of the carved furniture. The ornamental pottery and bric-a-brac were collected from various museums to show characteristic Russian art of various periods. One entire wall is covered by a hand-painted map of the world, by Ingenier Prochanof, with Russian text, the only large Russian map on the grounds, and Russian visitors are further attracted by files of newspapers and periodicals. Mr. U. Grant Smith, brother of the general manager of the Russian Westinghouse Company, is in general charge of the Russian exhibit, and Gospodin M. N. Konshin, of St. Petersburg, receives and welcomes his countrymen at the Fair.

Exhibits at the Illinois State Electric Convention.

At the Illinois State Electric Association Convention October 5 and 6, reported elsewhere in this issue, the Decatur Railway & Light Company had set aside a large room in the rear of its offices for the exhibition of electrical specialties. A number of electrical manufacturing companies took advantage of this opportunity for a display of goods.

Emerson single-phase alternating-current motors were shown in several small sizes, and an Emerson sewing machine attachment whereby an Emerson motor can be fastened to the lower frame of a sewing machine and the sewing machine operated by means of friction drive was one of the notable features of this exhibit. The armatures of these motors are now provided with self-contained automatic starting governor and short-circuiting appliance. E. L. Barkhouse, of the Emerson Electric Manufacturing Company, was in attendance.

The Fort Wayne Electric Works exhibited the Fort Wayne induction motor, which is in such extensive use by small companies operating alternating-current circuits. W. C. Knight, J. H. Raymond and Nathan Kohn represented this company.

The Sangamon Electric Company excited much interest with its commutatorless direct-current meter. With this meter the necessity for an ordinary commutator is done away with by a mercury contact device, which also serves to float the weight of the armature and prevent wearing at the bottom jewel. J. Hodder represented this company, and Arthur O. Einstein of the Electric Appliance Company, of Chicago, which sells this meter, was also in attendance.

The H. Mueller Manufacturing Company, of Decatur, showed several of its machines for tapping gas and water pipes under pressure and also tools used by gas and water companies. This company's large factory is at Decatur, where it is one of the substantial enterprises of the town. The convention was entertained with an after theatre lunch at this company's works on Wednesday evening, the affair being much enjoyed.

Porter & Berg, of Chicago, exhibited samples of many of the electric railway supplies for which they are agents, as many of the electric light companies attending the convention are also operating electric railways. The feature which probably attracted the most attention was the new soldered bond made by the Ohio Brass Company. The process of soldering was shown on Wednesday afternoon. J. W. Porter, who was in attendance, assisted by E. R. Mason, reports that more soldered bonds are being sold at present than any other kind.

Other companies having representatives at the convention were: Wesco Supply Company, R. S. Wakefield; Ewing-Merkle Electric Company, W. G. Brown; Westinghouse Electric & Manufacturing Company, W. R. Pinckard and H. R. Brooks; National Electric Company, R. P. Burton; General Electric Company, F. N. Boyer, Thomas Ferris, S. F. Dibble and J. A. Nicholson; Nernst Lamp Company, D. P. Oatman; Bryan-Marsh Company, J. S. Corby; Wagner Electric Manufacturing Company, C. E. Delafield; American District Steam Company, H. C. Eddy, O. McClure; Electric Supply & Fixture Company, Decatur, C. C. Gibson; Illinois Electric Company, D. Newman.

Sargent & Lundy, consulting engineers, were represented by F. Woodmanse. When the convention visited the Riverton power house on Thursday afternoon, Mr. Woodmanse showed the visitors various engineering features in this power house for which Sargent & Lundy are the consulting engineers.

New Whitney Hot-Wire Measuring Instruments.

The 1904 edition of the Whitney Electrical Instrument Company's pocket catalogue of its measuring instruments shows a line of voltmeters and ammeters of the hot-wire type, on which this concern has been working for a long time past. The principle on which these instruments operate is novel, and it is claimed that they constitute a distinct advance in the art of measuring apparatus of this class. Fig. 1 herewith is a diagrammatic illustration of the underlying principle.

A wire, *a-b*, of high resistance, low temperature coefficient and non-oxidizable metal, is secured at one end to a plate, *c*, passed

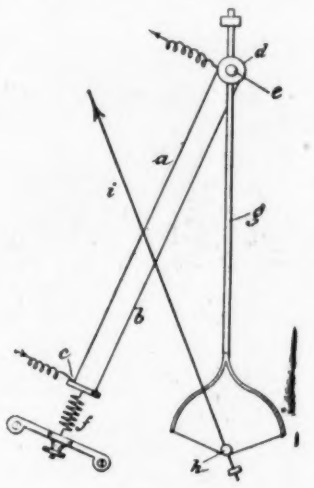


FIG. 1.—DIAGRAM SHOWING PRINCIPLE OF HOT-WIRE INSTRUMENT.

around a pulley, *d*, secured to a shaft, *e*, and its free end brought back again and mechanically though not electrically attached to the same plate, *c*. Plate *c* is kept under stress by the spring, *f*, which constantly tends to pull it in a direction at right angles with the axis of the shaft, *e*, and is so guided that it can be moved in that one direction only. To the shaft, *e*, is likewise secured an arm, *g*, bifurcated at one end and counterweighted at the other. Between the extremities of the bifurcated ends of the arm, *g*, is another shaft, *h*, on which there is a small pulley and to which is attached the needle, *i*, that gives the desired indications. A fine silk fibre is attached at one end to one of the arms of *g*, then passes around the pulley and the staff, *h*, and finally has its other extremity secured to the other arm. The arms are springy and serve to keep the silk fibre taut. The current to be measured flows through the wire, *a*, only, entering and leaving

FIG. 2.—HOT-WIRE MEASURING INSTRUMENT.

as indicated by the arrows. Evidently, when *a* is heated by the passage of current, it expands, which, as *a* and *b* were originally under the same tension, makes *a*'s tension relatively less than that of *b*, and equilibrium can be restored only when the pulley, *d*, rotates sufficiently to again equalize the strain. The rotation of *d*, of course, carries *g* with it, and *g* in moving causes the silk fibre to rotate the shaft which carries the needle. If the temperature of the air surrounding the instrument changes, *a* and *b* are affected alike and their resulting equal expansion simply results in a movement of the plate, *c*, back or forth in its path without any tendency to rotate the pulley.

The advantages claimed for the above construction are: First, that the member which compensates for the expansion of the active wire due to the temperature changes of the surrounding atmosphere, is a piece of the same wire, and hence the compensation must, therefore, be perfect. Second, unlike in former types of hot-wire instruments, the only tension on the wire is that of the spring, *f*, which in practice is found to be only a small fraction of that necessitated by the older construction. The less the wire is stressed, the less will naturally be the fatigue, and hence the less the error due to this cause. Repeated tests have so far failed to disclose an error due to that cause of over three-quarters of one per cent., and this error entirely disappears if, after being left in circuit for a few minutes, the current is temporarily disconnected, the instrument needle adjusted to zero by the simple means provided for that purpose and more particularly described later on, and current again turned on.

The new instruments being normally worked at a lower temperature than former types, there is a margin of safety such that an overload sufficient to cause the indicating needle to swing over 120° beyond the extreme normal limit of the scale when the cap is removed, may be carried continuously without even affecting the calibration.

The zero adjustment used in this new line of apparatus is also novel. The entire moving system, diagrammatically shown in Fig. 1, is mounted on a single base plate free to rotate over a small angle around a heavy shaft secured to it immediately below and in line with shaft *h* around which the needle swings. By means of a lever secured to this base plate and projecting slightly beyond the cap that covers the mechanism, the position of the needle relative to the scale may be altered at will without interfering with the wire in any way.

While already nearly dead beat in their action, an auxiliary damping device, not shown in Fig. 1, is employed, this consisting of an aluminum disc secured to the shaft to which the needle is attached and swinging between the jaws of a small permanent magnet.

The above instruments are made in both portable and switchboard patterns of any range from three volts upward and 200 milli-amperes upward. The ammeters are all worked on shunts, which are contained inside of the instrument case in the small sizes and are separate in the large ones. An idea of the sensibility can be obtained from the statement that the ammeters work on shunts giving a drop of but 200 milli-volts, which is considerably less than anything heretofore attained. An illustration of a portable voltmeter of this class is given in Fig. 2.

Machado & Roller, 203 Broadway, New York City, are the general sales agents for Whitney electrical instruments.

Highest Head Transmission Plant.

The Central California Electric Company, which is controlled by the same interests as the South Yuba Water Company, and is operating three water power electric plants transmitting electric power to Sacramento, Grass Valley and other cities, is figuring on a new water power plant. Preliminary surveys have been made and Superintendent Rudolph Van Norden is engaged on the preliminary engineering work. It is proposed to install a hydroelectric plant with a capacity of about 25,000 hp. It is the intention to locate the new installation on the banks of the American River at Alta Station, 60 miles from Sacrameno, in a direct line. The tail water from the present power station at Alta is to be conducted by a short canal to a point where a drop of 2,100 ft. can be obtained by use of a pipeline. It is said that the water wheels will be operated under the highest head in the world. The hydraulic machinery is to be designed by the Stilwell-Bierce & Smith-Vaille Company—now the Platt Iron Works. The wheels will be constructed along lines similar to those of the Escher-Wyss wheels, built for high-head plants in Switzerland. There will be four direct-connected units, the polyphase generators to have a capacity of either 4,000 or 5,000 kw each. The turbine wheels will have the water admitted to the buckets internally and will be about 4 or 5 ft. in diameter. An innovation will be the high speed of the generators—750 r.p.m.

The Central California Electric Company has an authorized bond

issue of $2,000,000, which will be taken care of by the Van Norden Trust Company in amounts necessary when money is needed to pay for extensions and new plants. It is probable that the entire output of the new generating station will be purchased by the California Gas & Electric Corporation under a long-term contract. At present the Central California Electric Company is disposing of the greater part of the capacity of its three power stations to the California Gas & Electric Corporation. This power is transmitted 32 miles from the present station at Alta to the Colgate power station, whence it goes 60 miles to Sacramento, via the Bay Counties' transmission lines. Three thousand horse-power is now being delivered under a ten-year contract and next spring the amount will be increased to 4,000 hp. By this arrangement the California Gas & Electric Corporation will prevent the building up of a possible serious competitor in its distributing field and the Central California Electric Company is saved the expense of building branch lines.

Lava for Electrical Purposes.

The mineral known as talc has in a manufactured form come very largely into use of late years for electrical not less than mechanical purposes, and a growing industry is based upon its use. An interesting and well-written pamphlet just issued by the American Lava Company, of Chattanooga, Tenn., gives information of more than ordinary value on the subject.

In order to make what is now universally though incorrectly known as "lava," the mineral talc (H_2, MG_3, SI_4, O_{12}) is machined in its natural chalky condition and then baked under certain conditions of time and temperature (about 2,000° F. or 1,100° C.) to a condition of such extreme hardness that when properly kilned it can scarcely be cut except by diamond. The material, being baked as stated at a temperature of about 2,000°, is unaffected by any subsequent temperature short of that heat, and therefore by any heat to which it may be exposed when used in the construction of arc lamps, rheostats, electric heating apparatus, etc.—in fact, under any conceivable circumstances a lava insulator would withstand a far greater heat than the conductor which it protected.

It fuses with difficulty under a strong blast flame and has no superior in withstanding the electric arc. It is only slowly dissolved by hydrochloric acid and is not affected at all by other acids or by alkali. It is absolutely free from metal oxides or other impurities which would impair its insulating value. It is permanent

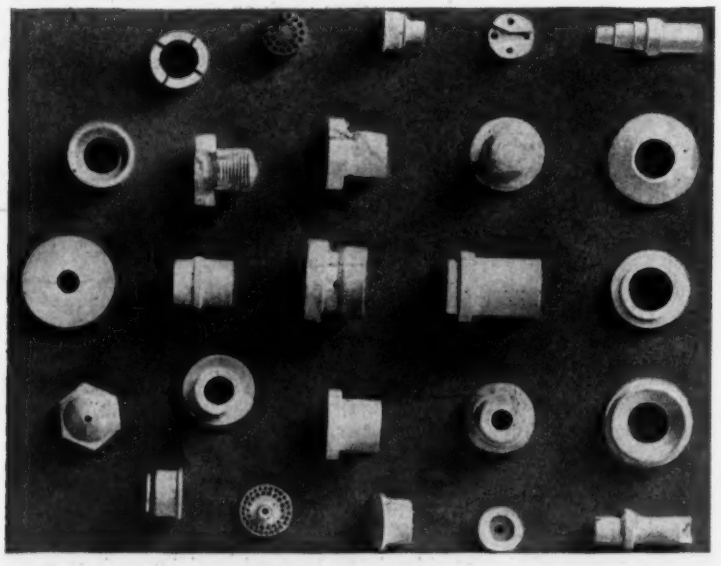


FIG. 1.—LAVA FOR ELECTRICAL PURPOSES.

in constitution and, being a natural product, is not subject to variations in structure or composition. It neither swells nor shrinks with changes in atmospheric moisture, and its coefficient of expansion with temperature being negligibly small, it is of especial value in instruments requiring a fixed relation of their parts under all conditions.

The material before baking is sawn, milled, drilled, turned and threaded with the same freedom as metals, such as brass, and by tools of the same character. Lava products are produced with the same degree of accuracy and interchangeability as those of a screw machine and without the necessity of first making dies or molds. For most work and for pieces of bulk the method of making is much the same as with porcelain, where coal and coke ovens are used, while with pieces of moderate size, and especially where close control of temperature is desired for the purpose of extreme accuracy and uniformity, the electric furnace or gas blast furnaces are employed.

With respect to accuracy, from the method of working highly satisfactory results are clearly obtainable. Arc lamp carbon-guide bushings are made in thousands according to limit gauges allowing from but one and one-half to less than one-half of one per cent. total variation in dimensions. For a kilned product, lava offers unusual advantages in respect to uniformity.

Many tests for dielectric strength made with transformers of large

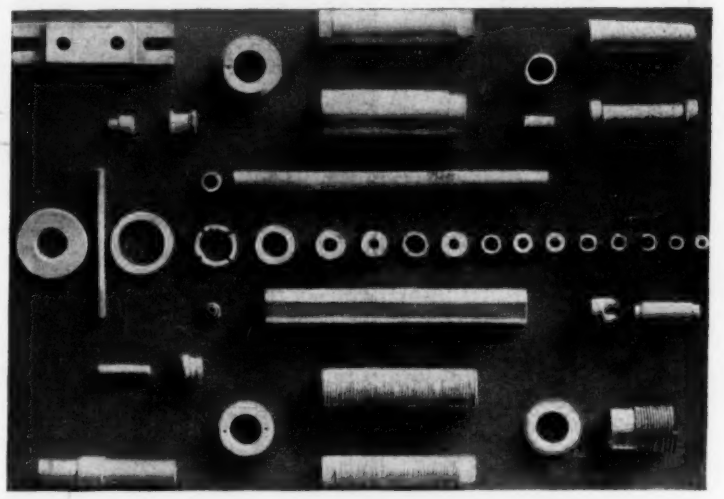


FIG. 2.—LAVA FOR ELECTRICAL PURPOSES.

capacity and carefully calibrated electrostatic voltmeters have demonstrated that lava is remarkably uniform in its ability to withstand high potentials, not only momentarily, but when continued indefinitely, as its "dielectric hysteresis" and surface creepage loss cause no more heating under continued stress than in the case of porcelain under the same conditions. Its dielectric strength may be expressed as from 75 to 250 volts per thousandth of an inch thickness, depending, as in the case of all other electrical insulators, upon the absolute thickness of the sample tested.

From the foregoing it is evident that there are many opportunities for the use of lava outside of electric insulation. It being acid proof and superior to porcelain and glass in heat-resisting qualities, as well as in strength, and being turned cheaply in moderate quantities without the cost of dies or molds, it is for many purposes the most practicable of the materials possessing any of the above qualities, while no other material now in use combines them all. As compared with wood, horn, fibre and compositions of rubber, etc., it is said to be frequently cheaper and always better. As compared with mica, lava lends itself to a large variety of shapes in which mica cannot be employed.

Cost being an important consideration, it is worth while to call attention to the fact that improvements and economies in lava working have kept pace with the times, with the result that the price of lava has now reached a point where it competes with most of the commoner insulating materials. Particular emphasis is laid on this point for the reason that lavas, which were superseded five or six years ago by other materials in an effort to cheapen production, are now procurable at one-half and in many cases at one-fourth the former costs.

Everything being made up according to the requirements and designs of apparatus manufacturers, there are no standard forms which can be catalogued or priced, but the cuts illustrate a very few of the uses to which some of the electrical manufacturers are putting lava.

Power Plant for Indian Docks.

The Calcutta (India) Port Commissioners have decided to construct a large power plant on the Kidderpore docks. Fully $100,000 will be expended in equipment. American interests are figuring on the contract.

The Exhibit of the Gould Storage Battery Company.

The exhibit of the Gould Storage Battery Company occupies the northern portion of Section 16 of the Palace of Electricity at St. Louis. A space 80 ft. long by 21 ft. deep is occupied by the display of storage batteries, boosters, switchboards and other apparatus used in the operation of the batteries.

Quite an elaborate display is made of batteries. These vary in size, from those measuring 3 in. by 3 in., the smallest manufactured by the company, to the largest, measuring 30½ in. by 15½ in.

A new size of plate which has been recently brought out by the Gould Company is exhibited. This measures 18½ in. by 18½ in.

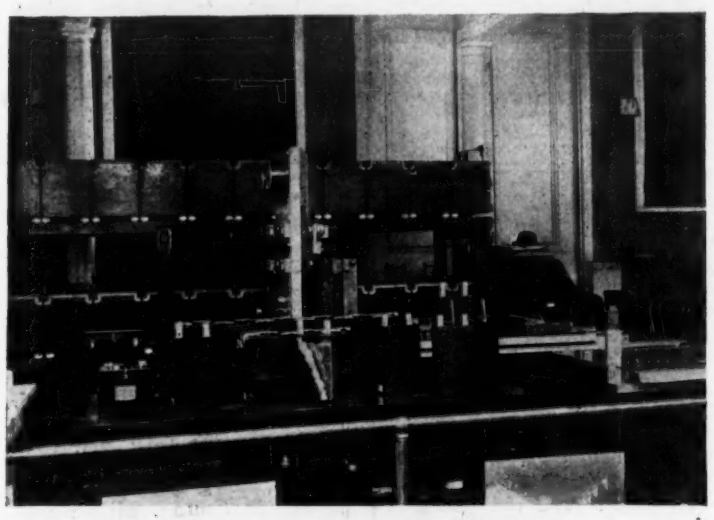


FIG. 1.—CENTRAL PORTION OF EXHIBIT.

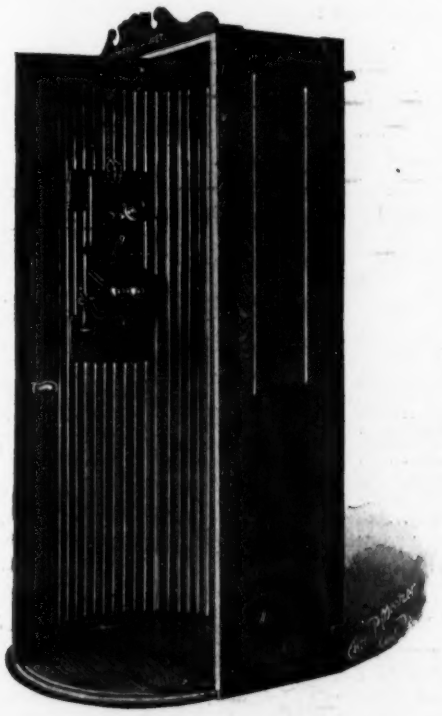
and is designed for use where floor space is valuable and where the deeper plates are not thought advisable. Three cells with this type of plate, which has been designated "Type U," are exhibited. Each contains 49 plates and has a rated capacity of 5,700 amp.-hours. The largest cell shown is one holding 101 "T" plates, with rated capacity of 16,000 amp.-hours. This battery, it is said, has a momentary discharge capacity of 30,000 amp. Other cells are shown of the "B" and "O" types. One feature of the exhibit is a complete

FIG. 2.—SWITCHBOARD AND COUNTER-E.M.F. BOOSTER.

isolated plant of 60 cells, type "O-7" in "O-13" lead-lined tanks, together with end cell connections, complete switchboard and booster auxiliary. This battery is used for lighting the booth. In addition to the stationary cells are shown portable ones and those designed particularly for railroad train lighting. Another part of the exhibit is composed of electric vehicle cells, showing the use of an electrochemical positive and pasted negative. This combination is said to give very excellent results, together with long life. The separators in the automobile cells are entirely of rubber, no wood being used. All of the stationary work shown is finished in polished oak, which gives a very handsome appearance. Large photographs of typical Gould plants are distributed about the booth. A set of cells for train lighting is shown in connection with the Gould car lighting system. A very handsome blue Vermont switchboard consisting of six panels of blue Vermont marble has been erected to be used in connection with the various batteries, motors and generators in the exhibit. This is shown in the accompanying reproduction of a photograph. The separate panels show the standard switchboard sold by the Gould Company for floating railway batteries, booster regulating batteries, isolated charging plants and for the special features shown in connection with the plant. A motor-generator set taking current at 220 volts on the motor side and delivering 110 volts to the motor of the counter e.m.f. booster set is also shown. This appears in one of the accompanying reproductions. The booster charges 60 cells of battery and with it the method of applying the Gould booster system to the regulation of varying loads is demonstrated.

Folding Telephone Cabinet.

One of the necessities accompanying the increased use of the telphone is that of greater privacy, to which end the telephone cabinet has been worked out with much ingenuity. Some of the earlier cabinets were quite ponderous and massive affairs, something like a stateroom, with equal capacity in the direction of stuffiness; but the later developments in the line of economy of space, privacy, ventilation and other essential features may be judged from the interesting illustration here shown. This cabinet occupies about one-third the space of the regular standard booth. It is a handsome piece of furniture, being constructed entirely of hard wood, finely finished. The



FOLDING TELEPHONE CABINET.

telephone wires enter through the pivotal center in the top, and are carried to the wall telephone, which is attached to the rolling section, or in case a desk telephone is in use, a shelf is placed conveniently arranged for holding it.

The cabinet is sent out completely finished, and can be set up by any one, as only a few screws are required to attach it firmly to the wall. As will be observed, the cabinet is based virtually on the idea of the roll top desk, so that it is like Oliver Goldsmith's bed, "contrived a double debt to pay," serving alike as an open or a closed booth. The cabinet projects only 17 in. from the wall, it has no door opening inward or outward, and has a clear space inside of 30 by 32 in. There is plate glass 36 by 7 in. in both the sides, providing ample light. The bottom is hinged at the semi-circle for convenience in crating and carrying through narrow halls and doorways. When closed for use the cabinet occupies only 35 by 35 in. of floor space. It is known as the "Perfected Attick," and is manufactured under patents by the Folding Cabinet Company, of Lancaster, Pa.

NEWS OF THE WEEK.

Financial Intelligence.

THE WEEK IN WALL STREET.—Trading during the first half of the week was characterized by heavy transactions, the record of Wednesday being 1,350,000 shares—the largest single day's dealings of the year. The market afterward assumed a reactionary tendency, though prices steadied and showed a firmer tone. The United States Steel stocks reacted from their higher lever, but were supported, while considerable strength appeared in Amalgamated Copper, Brooklyn Rapid Transit and some of the specialties. Brooklyn Rapid Transit reached the highest quotation of the year, 59⅜, but receded and closed at 58⅞, this being a net gain of 1½ points. The sales of this stock aggregated 137,610 shares. The prices of Metropolitan Street Railway ranged between 118¾ and 112, closing at 120⅛, a net loss of 1⅜ points. Interborough Rapid Transit closed at 147. General Electric is the only one of the electrics that did not show a gain in price in the week's transactions. It reached 174⅛ at one time, but fell off and closed at 172, this being a net loss of 1½. Allis-Chalmers preferred is unchanged at 50, while common is ⅞ higher, the closing quotation being 11⅞. Westinghouse common made a net gain of ½ point, closing at 165½. Western Union Telegraph advanced to 92, at which figure it closed, this being a net gain of 1¼. American Telephone & Telegraph is a fraction higher, the closing quotation being 139½. On the "Curb" prices were irregular, with some sharp advances, though most issues receded under profit-taking. Transactions were heavy. Following are the closing quotations of October 11:

NEW YORK

	Oct. 4	Oct. 11		Oct. 4	Oct. 11
Allis-Chalmers Co.	11⅛	10	Electric Vehicle	16¾	14
Allis-Chalmers Co. pfd.	49	42	Electric Vehicle pfd.	23¾	20
American Tel. & Cable.	90	92	General Electric.	172	171
American Tel. & Tel.	139	139⅛	Hudson River Tel.		
American Dist. Tel	23	24	Interborough Rap. Tran.	148⅛	146
Brooklyn Rapid Transit.	58	60¼	Metropolitan St. Ry.	120¾	120⅝
Commercial Cable.	190	200	N. Y. & N. J Tel.	157⅛	156
Electric Boat.	37	37	Marconi Tel.		
Electric Boat pfd.	69	69	Western Union Tel.	91¾	91¼
Electric Lead Reduction	¾	¼	Westinghouse com	164	165
			Westinghouse pfd	185	190

BOSTON

	Oct. 4	Oct. 11		Oct. 4	Oct. 11
American Tel. & Tel.	139⅛	139	Western Tel. & Tel. pfd.	91½	93
Cumberland Telephone	117	116½	Mexican Telephone	1⅜	1¼
Edison Elec. Illum.	*257½	*254¾	New England Telephone	130	130½
General Electric	172½	171	Mass. Elec. Ry	13¼	13⅛
Western Tel. & Tel.	13	13	Mass. Elec Ry. pfd.	57⅛	55

PHILADELPHIA.

	Oct. 4	Oct. 11		Oct. 4	Oct. 11
American Railways	48	47⅛	Phila. Traction	97⅛	97⅛
Elec. Storage Battery	64⅛	68¼	Phila. Electric	7	6¼
Elec. Storage Battery pfd.	66¼	66⅛	Phila. Rapid Trans.	15	15
Elec. Co. of America	9⅜	9¼			

CHICAGO

	Oct. 4	Oct. 11		Oct. 4	Oct. 11
Central Union Tel.	...	...	National Carbon pfd.	108	108¼
Chicago Edison	152	155	Metropolitan Elev. com.	22	23¼
Chicago City Ry.	175	170	Union Traction	7¼	7
Chicago Tel. Co.	122½	125	Union Traction pfd.	38	35
National Carbon	32⅛	32			

* Asked

BOSTON EDISON COMPANY REPORT.—The nineteenth annual report of President C. L. Edgar to the Edison Electric Illuminating Company of Boston, for the year ended June 30, 1904, compares with previous years as follows:

	1904.	1903.	1902.	1901.
Gross	$3,125,516	$2,667,808	$2,460,158	$2,367,359
Expenses	2,009,691	1,683,085	1,510,427	1,449,629
Net	$1,115,825	$984,723	$949,731	$917,730
Miscellaneous profits	37,396	32,501	25,981	13,948
Total net	$1,153,221	$1,017,225	$975,712	$931,678
Interest and dividends	1,075,813	955,970	859,614	879,285
Surplus	$77,408	$61,253	$116,098	$52,393
Lamp and motors connected as of date June 30, follow:				
Incandescent lamps	627,441	493,402	442,034	247,935
Arc lamps	9,358	8,196	8,548	2,503
Motors, horse-power	24,150	20,801	19,130	10,951

Of the above increase in lamps and motors the past fiscal year 72,745 incandescent lamps, 760 arc lamps and 218 hp of motors were added in the purchase of the Milton Light & Power, the Dedham Electric, Blue Hill Electric, the Framingham Electric, the Natick Gas & Electric, the Greendale Chemical & Electric Light and the Somerville Electric Light companies. The remainder, 61,294 incandescent lamps, 402 arc lamps and 3,121 hp motors, is the increase in new business for the year. The balance sheet as of date June 30 follows:

Assets:	1904.	1903	1902.	1901.
Installation	$16,251,146	$13,268,196	$11,951,626	$5,708,060
Liverpool wharf	.....	.....	225,912	225,912
Cash on hand	135,339	106,275	165,914	64,557
Stock on hand	409,342	337,466	361,160	78,440
Notes and accounts rec'd	1,757,471	2,514,749	246,778	121,366
Open accounts	78,130	196,741	37,613	88,152
Totals	$18,631,429	$16,423,427	$12,989,005	$6,286,487
Liabilities:				
Capital stock	$10,444,500	$8,635,500	$7,850,400	$4,310,600
Mortgage bonds	1,342,000	1,250,000	1,250,000	180,000
Not. and acts. pay.	1,314,805	2,970,888	1,247,789	792,177
Dividends payable	261,112	215,887	196,260	107,762
Instal. new stock	.....	23,000	.....	.....
Reserve for maintenance	806,930	755,735	645,000	506,000
Subsidy open account	.....	.....	.....	41,403
Premium on new stock	4,261,250	2,450,244	1,660,387	333,535
Accrued interest and tax.	84,511	62,050	69,217	.....
Replacement account	4,644	19,389	.....	.....
Coupon notes	59,500	.....	.....	.....
Profit and loss	52,174	40,631	60,951	15,109
Totals	$18,631,429	$16,423,427	$12,989,005	$6,286,487

President Charles L. Edgar says: The results obtained by the purchase of the suburban companies, as well as the growth of the combined companies during the year, have been satisfactory. The property of the Somerville Electric Light Company has been purchased and a contract has been entered into with the Chelsea Gas Light Company for supplying that company with all its electricity until such time as the final purchase of its electric property is consummated. The new turbine power station which has been building during the past two years, is practically completed, and two 6,500-hp units have been installed. Property has been leased at No. 40 Summer Street and at No. 56 Chatham Street for additional sub-stations, and a storage battery is now being installed in the latter place. The old generating stations in Canton, Milton and Needham have been discontinued, and the Dedham station turned into a sub-station. It is proposed to discontinue the generating gestation in Framingham and to change the Natick station into a substation as soon as the transmission lines are completed. The Somerville station will continue to operate for some time. In December, a 10 per cent. increase in the capital stock was issued, of which all but 46 shares was taken by stockholders. Notes have been issued from time to time as payments on the new station became due, and the stockholders will probably be called together some time during the coming winter to authorize the issue of another 10 per cent. of capital stock, authority to issue this amount having already been granted by the Board of Gas and Electric Light Commissioners.

GENERAL ELECTRIC ACTIVITY.—Rumors are afloat again that an advance in General Electric's dividend to 10 per cent. is more than a possibility. The company, it is claimed, has now an unseen surplus of fully $20,000,000 in its property account and by the end of its fiscal year it will have accumulated a cash surplus of $10,000,000 more. From orders already booked and work in prospect it is evident that 1905 will be a year of great activity. Inquiries from railways for conversion work are more numerous than ever and orders already booked for this new class of business are understood now to exceed 50 per cent. of last year's entire output. Probably more than $15,000,000 of business will be done in turbine engines. This is also new work.

MERGERS IN PENNSYLVANIA.—The Citizens' Telephone Company, of Newcastle, Pa., the Union Telegraph & Telephone Company and the Mercer County Telephone Company are included in a merger of all independent companies of Western Pennsylvania and Western New York under the name of the Erie Telephone Company. The Luzerne County Gas Company and the Wyoming Valley Electric Light Company will be consolidated under the name of the Wilkesbarre Gas & Electric Light Company.

COMMERCIAL CABLE STOCK.—President Mackay, of the Commercial Cable Company, in a communication to shareholders, offers $1,000,000 unissued share capital of the company pro rata at par upon the following conditions: Each shareholder of record October 25 shall have the privilege to subscribe to one new share for every fifteen held on that date. Subscriptions must be made not later than October 25 and accompanied by payment in full for shares subscribed for. The right to subscribe will cease on that date.

CHICAGO ELEVATED BONDS.—Subscriptions for $3,000,000 South Side Elevated 4½ per cent. bonds offered to stockholders of the road by the Illinois Trust & Savings Bank at par closed Friday. The bonds were slightly overscribed.

THE KINLOCH TELEPHONE COMPANY of St. Louis has filed a certificate of increase of capital stock from $2,000,000 to $3,000,000.

Commercial Intelligence.

THE WEEK IN TRADE.—Improvement is the keynote to the trade situation. With the crops almost all beyond danger, prices of securities at the highest point since May of last year, and hitherto idle machinery running at many factories that had been shut down for a long time, the business outlook grows steadily brighter, according to all the trade reviews. The best feature of the situation is the confidence expressed by the increased disposition to provide for future requirements. This is by no means general, but it is noticed at pig iron furnaces, woolen mills, and among dealers at widely separated points, particularly those located in the agricultural sections. Mercantile collections are more prompt, and railway earnings for the month of September were 3.8 per cent. larger than in the same month last year, while foreign commerce at the port of New York for the week shows increases of $1,051,208 in imports and $410,748 in exports as compared with a year ago. Bradstreet's states that in the iron and steel trade the railways are reported buying fairly of rails and freely of material and rolling stock. Agricultural implement men are buying bars, and shipbuilders are taking plates better than at any time this year. Copper is active and higher, foreign demand being conspicuous. The West and Northwest show the most activity in current distribution, while in the East business is not so active in some industrial centers which are feeling the effects of the spring and summer depression in the building or textile industries. Bradstreet's reports the number of business failures for the week ending October 6 as 195, against 179 the week previous, and 197 the corresponding week last year.

CALUMET & HECLA ELECTRICAL PLANT.—The Calumet & Hecla is about to establish a mammoth electrical power plant convenient to its smelting works at South Lake Linden, Mich. This will be one of the biggest power plants the world has seen, for it will include all features of the work. The building foundation is nearly completed, and, as the necessary equipment has long since been contracted for, the plant will unquestionably be in commission next year. Power will be supplied from this source to practically the entire mechanical equipment at the mine and mill, with the exception of the hoists and stamps. The wash portion of the new mill is operated by electrical power, and it is understood that this feature will be introduced in the old Calumet & Hecla mills. At the mine the blacksmith and machine shops will be equipped for the use of electrical power, which is already being used to operate the underground pumps. Even the water-works system on the shore of Lake Superior will derive its power from this source. It is expected that the item saved in the fuel account will be something enormous. The discontinuance of fuel shipments from South Lake Linden to the mine and water-works will, in itself, result in a big saving. The annual coal receipts of the company are about 225,000 tons. The consulting engineer selected for this vast undertaking is Mr. W. E. Baker, so well known in connection with heavy electric traction in Chicago and on the New York Elevated. He has his offices at 27 William Street, New York City.

IMPROVEMENT IN GRAVITY BATTERIES.—Mr. W. N. Gove, 924 Arch Street, Philadelphia, Pa., is the inventor of an amalgamated plate for gravity batteries, which is claimed to be an improvement in this time-honored source of current. The plate is a substitute for the copper element, and is composed of several different metals, which, it is stated, give it great durability. It weighs only ¼ pound and is placed directly on top of the blue stone in the cell. The advantages claimed for it, as compared with the ordinary copper element, are cleanliness, durability and low cost. The signal and telegraph departments of the Pennsylvania Railroad have given the plates a practical test, it is stated, with much satisfaction. Tests are also being conducted by the Lehigh Valley and Reading Railroads. Mr. Gove proposes to sell the right to manufacture these plates.

AUTOMOBILE IMPORTS.—It is stated that during the nine months ended October 1 427 automobiles had been imported at the port of New York, this number being just about double that imported during the same period last year. The total value of the 427 machines was $1,600,000, giving an average of about $3,750 for each machine. During the last month there have been several high-grade racing machines imported. The duty paid on the machines at 45 per cent. amounted to $720,000. These figures only include automobiles entered in the regular way, and on which duty was paid. In addition there have been a large number imported under bond for touring purposes. The majority of the machines come from France and Germany. So far as is known, not any of these machines are electric, but all gasolene.

INDEPENDENT PRIVATE EXCHANGES.—The independent telephone companies are rapidly coming to the conclusion that a great deal of revenue may be derived through operating private branch exchanges in certain localities. An instance of this is shown by the recent equipment shipped to the Topeka Independent Telegraph & Telephone Company, Topeka, Kan. This calls for a private branch exchange equipment for installation in the High School at Topeka. The subscribers' lines for private branch exchanges are supplied with current from a local installation of dry batteries, this plan having been thought the most economical one by the Topeka Company. The equipment further consists of complete arrangement for incoming and outgoing trunk circuits. The switchboard was built by the American Electric Telephone Company, of Chicago.

THE NORTHERN ELECTRICAL MANUFACTURING COMPANY, of Madison, Wis., recently shipped to the New York Edison Co. thirty-four of its variable speed motors operating on the Northern two-wire field control system. These motors will be directly coupled to blowers for cooling the transformers in the various substations of the company. There were also shipped recently nine small Northern motors to be installed in the sub-stations of the Brooklyn Rapid Transit Company. This makes a total of seventy-five Northern motors now in use by the two companies, aggregating 1,500 hp. A 60-kw Northern balancing set has been shipped to the New York Edison Co., for the equipment of its Waterside station.

EQUIPMENT FOR APARTMENT HOUSE.—Contracts have just been let for the equipment to be installed in the Peter Banner apartment house under construction at Eighty-ninth Street and Central Park West, New York. Mr. Percival Robert Moses, of 35 Nassau Street, is consulting engineer. The generators will be built by the General Electric Company. There will be two machines of 80-kw capacity each and one of 65-kw. The larger generators will be direct-connected to Reeves simple automatic high-speed horizontal engines, 14 in. x 14 in., while the 65-kw generator will be driven by a 13-in. x 12-in. engine of the same type. Mr. Fred. Pearce, of 18 Rose Street, will execute the wiring work.

THE STANLEY ELECTRIC MANUFACTURING COMPANY has closed a contract for an additional 200-kw, three-phase, 6,600-volt generator for the Standard Consolidated Gold Mining Company, of Bodie, Cal. This is a duplicate of the first generator installed by the Stanley Company to replace the historic first single-phase, high-tension transmission plant in California. This was installed simultaneously with the first high-tension transmission in Colorado. Electric power is transmitted to many mining plants in the districts surrounding Bodie. R. G. Brown is manager of the San Francisco office of the Standard Consolidated Company.

DODGE & DAY, engineers, Philadelphia, Pa., have placed the orders for generators and motors for Alexander Brothers, Philadelphia, with the Western Electric Company; for the shafting, hangers, etc., with George V. Cresson Company, and wiring with Buchanan Company, all of Philadelphia. This firm of engineers have just been commissioned to install a heating system in the building lately acquired by Alexander Brothers, at No. 412 North Third Street, Philadelphia, and have also taken charge of the installation of additional motors at the plant of Schaum & Uhlinger, Second Street and Glenwood Avenue, Philadelphia.

EQUIPMENT FOR BIG GRAIN ELEVATOR.—A monster grain elevator is to be built at Water and Corlears Street and East River by the Hecker-Jones-Jewell Milling Company, whose offices are in the Produce Exchange Bldg., New York, and considerable electrical equipment, it is understood, will be installed. The contract for the construction of the elevator has been awarded to Barnett, Ricard & Company, of Minneapolis, Minn. Mr. W. D. Gray, of 205 Cherry Street, New York, has been retained to act as engineer for the power plant installation.

THE STURGESS GOVERNOR ENGINEERING COMPANY has recently booked another order for one No. 3 size, A type, water-wheel governor, for the Hudson River Water Power Company's plant at Spier Falls. It has also secured an order for another governor for J. & E. H. Wilson, Pittsfield, Mass.; one for the Pelton Water Wheel Company, for export to Brazil; two 15" Sturgess relief valves and one governor for the Rochester Railway & Light Company, Rochester, N. Y., besides several others.

BIDS FOR WIRELESS TELEGRAPH POLES.—The Bureau of Construction of the Navy Department has asked for bids on twelve sectional wooden wireless telegraph poles for the proposed stations at Key West, San Juan, Panama and Colon. The poles will be 212 feet high—the tallest ever used in wireless operations in this country—and three will be installed at each of the stations.

ROSARIO WATER POWER FRANCHISE.—Mr. Guillermo Vega, of Rosario, State of Sinoloa, has been granted a franchise by the Mexican Government, which permits of the construction of a large water power plant on the Rosario River.

THE BALL ENGINE COMPANY, Erie, Pa., is in receipt of an order for two 1,000-hp horizontal cross compound Corliss engines, direct connected to alternators, for the People's Ice, Light & Storage Company, of McKeesport, N. Y.

General News.

THE TELEPHONE.

DECATUR, ALA.—The Morgan County Telephone Company has built a line to Trinity and will extend it on to Memphis, where it will have connections with all the principal cities east of the Mississippi River.

LITTLE ROCK, ARK.—The Sharp County Telephone Company will shortly begin the construction of a line from Franklin to Melbourne by way of Philadelphia, a distance of about 14 miles.

LOS ANGELES, CAL.—The Classified Telephone Directory Company has been incorporated with a capital stock of $10,000. The directors are E. E. Winchester, J. W. Kennedy, J. H. Trout, G. M. Ludwick and T. R. Archer.

ALLERTON, ILL.—The Central Union Telephone Company has just taken over the Home Company at Allerton and Sidell and is now operating there in connection with its own exchange.

PROPHETSTOWN, ILL.—The Farmers' Telephone Company here has constructed a trunk line to Erie.

LAWRENCEVILLE, ILL.—The following officers have been elected by the Starr Line Telephone Company which has been incorporated with a capital stock of $100,000: President, H. H. Knipe; vice-president, J. H. Senseman; secretary, G. W. Chamblin; treasurer, A. H. Calvin.

MONTICELLO, IND.—During a recent electric storm that passed over this city, the Monticello telephone system was burned out and the building in which it is located was badly damaged.

ELKHART, IND.—The Pullman Telephone Company has filed articles of incorporation with the Secretary of State. The capital stock is $10,000. John K. Johnson, M. E. Crow and M. A. Olds are the incorporators.

INDIANAPOLIS, IND.—The Western Grove Telephone Company has been incorporated with a capital stock of $320. The directors are W. F. Thomas, J. C. Hamilton, L. J. Burford and Sylvester Jessup.

LA PORTE, IND.—The telephone company intends to place all its wires in the down-town district underground and in time extend the same to the residential districts. The company expects to put about 10,000 feet underground this fall.

WOLCOTVILLE, IND.—The People's Mutual Telephone Company has filed articles of incorporation with the Secretary of State. The capital stock is $10,000. Daniel Strayer, Charles Kandal, A. W. Miller and others are the incorporators.

EVANSVILLE, IND.—Two additional telephone lines are to be built between this city and Cincinnati, Ohio, by the American Long-Distance Telephone & Telegraph Company. At present there are six lines. The two new ones will parallel these and will afford Evansville better service to all points along the line and in the East.

INDIANAPOLIS, IND.—Fifty thousand dollars are yet to be spent this season for wire in building toll lines, and a quarter of a million dollars in building toll lines and local lines next spring by the Indianapolis Telephone Company and the New Long Distance Telephone Company. The company has expended nearly $100,000 this year on the local plant.

MANSON, IA.—The Mutual Telephone Company will expend $4000 in improvements to the local exchange.

KEOKUK, IA.—The Telephone Construction & Manufacturing Company has been incorporated with a capital of $10,000. The incorporators are J. C. Hubinger and others.

DUBUQUE, IA.—The Iowa Telephone Company has decided to inaugurate soon a series of improvements in Dubuque that will involve the spending of over half a million dollars. A new exchange will be built, the wires all put underground and, in short, the entire system completely renovated.

BOONE, IA.—A trust mortgage has been given by the Boone County Telephone Company in favor of J. H. Herman, of Boone, trustee, for $50,000. It is understood that the money is to be used in the improvement of the telephone system, which enters Des Moines and covers large territory in Boone and adjacent counties.

WOLVERINE, MICH.—The Citizens' Telephone Company has increased its rates in the village of Lowell from $9 to $12 per year.

DETROIT, MICH.—The Michigan State Telephone Company has adopted the plan of central not calling back numbers. It is expected that the plan will result in a considerable saving of time, and as it has already been adopted in a number of cities it is expected that the new rule will become a permanent one.

BELLVIEW, MINN.—The Redwood County Mutual Telephone Company will establish a local exchange.

ST. PAUL, MINN.—The Northwestern Telephone Company is expending several thousand dollars improving its system in the Merriam Park and Selby and Prior districts. The central energy system is being installed.

ST. PAUL, MINN.—An injunction has been secured restraining the city engineer of St. Paul from cutting down poles of the Twin City Telephone Company. The council had ordered the poles removed and the city engineer began cutting them down, completely paralyzing the Twin City Company's long-distance service. Work will now be stopped until a hearing can be had.

NATCHEZ, MISS.—The Cumberland Telephone & Telegraph Company is installing a complete cable service in Vidalia.

HOLT, MO.—The Holt Telephone Company, of Holt, has increased its capital stock from $10,000 to $30,000.

MEMPHIS, MO.—The Memphis Telephone Company has sold its exchange to Dr. J. J. Risk for a consideration of $7000.

ARGENTINE, MO.—The Argentine City Council has granted the Home Telephone Company a franchise in that city. This company now has franchises in Kansas City, Mo., Kansas City, Kan., Rosedale and Argentine.

LIBERTY, MO.—The Missouri Independent Telephone Company, of Liberty, has been incorporated with a capital stock of $10,000. The incorporators are Logan Woodson, Paschal Parker, Samuel H. Woodson, Thomas A. Henderson and John A. Eby.

ST. LOUIS, MO.—The St. Louis County Telephone Company has secured a franchise to erect a line of wires in Ferguson, St. Louis County, and is asking for a similar franchise in Webster Groves. The company will have its telephone system in working order within a short time.

TILTON, N. H.—The Citizens' Telephone Company has begun to build a line to Northfield Center.

TRENTON, N. J.—The Telephone & Telegraph Company of New Jersey was incorporated recently with a capital stock of $250,000. The incorporators are Alfred E. Holcomb, Harry W. Brigham, George H. Minster, Samuel S. Moore and Robert Bain.

ELMIRA, N. Y.—The New York Telephone Company, after several years of continued effort, has succeeded in completing its line between this city and Binghamton and telephone connections have been established on the independent line.

GENEVA, N. Y.—The Central New York Telephone & Telegraph Company has just been granted the privilege of building an extension to the municipal subways in this city. The Central New York Company and others will use the extension.

AMSTERDAM, N. Y.—The Hudson River Telephone Company has sold out its interests in Fulton, Hamilton and Montgomery counties, excepting in the City of Amsterdam, to the Glen Telephone Company. The Glen concern now comes under the system of the American Telegraph & Telephone Company.

UTICA, N. Y.—At a recent meeting of the Central New York Telephone Company an appropriation of nearly $50,000 was recommended for the extension of the underground telephone system in this city. The company is greatly extending its work here and is expending about $100,000 in laying conduits.

IRONTON, OHIO.—The Central Union Telephone Company has opened its exchange in this city. The board has a capacity of 1500 telephones.

CLEVELAND, OHIO.—The Cuyahoga Telephone Company is offering to put in four-party lines in many east end homes free of charge for a period of four months. This is another move on the part of the Cuyahoga to develop business in the east end, and it shows a rather strenuous competition between the independent and the Cleveland Telephone companies.

CLEVELAND, OHIO.—The Ottumwa Telephone & Electric Railway Company has been incorporated with a capital stock of $150,000. The incorporators are J. A. Smith, E. A. Williams, C. K. Arter, F. L. Taft and E. M. Wagner, all of Cleveland. The newly incorporated company has purchased a telephone and railway plant now in operation in Ottumwa, Ia. The headquarters of the company will be in Cleveland.

NORWALK, OHIO.—The Oil Belt Telephone Company has been incorporated with a capital stock of $25,000. The incorporators are Harry E. Graham, C. M. Graham, E. N. Graham, Adelbert Graham and Joseph R. McKnight. The company will build exchanges at Cygnet, Portage and Jerry City, in Wood County, with connections and free service with the independent exchange at Bowling Green. It is estimated that over 150 miles of wire will be strung and 500 telephones installed.

RINGWOOD, OKLA.—The Star Telephone Company has been incorporated with a capital stock of $1000. The incorporators are W. L. and M. J. Miller and J. S. Huffman.

READING, PA.—The annual election of the Philadelphia, Reading & Pottsville Telegraph Company was held recently and resulted as follows: President, Geo. F. Baer; treasurer, Richard Tull; secretary, W. R. Taylor. Directors: Joseph S. Harris, Theodore Voorhees, C. E. Henderson and Samuel Dickson.

PROVIDENCE, R. I.—The Providence Telephone Company, together with the Southern New England Telephone Company, has virtually agreed to relinquish its rights in the towns of Westerly, Hopkinson, Richmond, Charleston, Stonington and North Stonington, to the Westerly Automatic Telephone Company, and by this means considerable confusion in telephone service which has existed in the southern part of the State will be removed. The Westerly Company will become a licensee of the American Telegraph & Telephone Company, and a sub-licensee of the Providence Telephone Company, and the wires of the latter company and those of the Southern New England Company will become the property of the Westerly corporation.

ORANGEBURG, S. C.—The Orangeburg & Raymond Telephone Company has been formed with $1000 capital. Directors. J. G. Smith and others.

OGDEN, UTAH.—The management of the Utah Independent Telephone announces that the system in this city will be prepared for operation within a few days. The exchange is now practically in readiness, and a carload of instruments are now ready to be installed.

EAU CLAIRE, WIS.—The Chippewa County Telephone Company, Ltd., is seeking an entrance into this city with its lines.

RILEY, WIS.—The Pine Bluff Telephone Company has been incorporated with a capital stock of $10,000. The incorporators are John Brown, John Birrenkett, Jos. F. Faust and Adolph Birrenkett.

Electric Light and Power.

NASHVILLE, ARK.—Bids will be opened on Oct. 16 for the construction of an electric light plant. The probable cost will be $5000.

LITTLE ROCK, ARK.—The question of purchasing new machinery for the electric light plant is under consideration by City Council. The probable cost will be about $9550.

EUREKA, CAL.—The Humboldt Water & Power Company, B. Von Homeyer president, has opened offices in the Georgeson Building, Eureka, Cal., with E. A. Spencer in charge.

JACKSON, CAL.—The Standard Electric Company has started improvements on a large scale at Electra. The United Gas & Electric Company derives power from Electra, where the Blue Lake plant is situated. Under normal conditions this plant is capable of generating 13,000 horse-power, sufficient to supply not only San Jose with heat, light and power, but also to provide current for Oakland, Stockton, Redwood City and San Mateo.

AMERICAN FALLS, IDA.—The American Falls Electric Company, Limited, has filed articles of incorporation with the Secretary of State, the directors of the new organization being William Burke, John L. Burke and L. V. St. Clair, of this city, and R. H. Johnson and S. H. Hayes, of Boise. The capitalization is $1,000,000. Pumps will be installed at the falls, the water raised 125 feet, and an area of 4000 acres of land irrigated by means of canals and laterals. With the completion of this end of the project, the company plans the construction of an immense dam below the falls, where 20,000 horse-power will be generated. The dam will be 300 feet high and 30 feet in width and will be constructed entirely of concrete.

ELIZABETH, ILL.—The Village Council has granted Howard Cook, of Chicago, a franchise for an electric light plant.

BENTON, ILL.—The electric lighting plant owned by the city was burned recently. The loss is about $7000. The city will be without lights until another plant is completed, work on which was immediately begun.

MUNCIE, IND.—The Muncie Electric Light Company will begin preparation for the erection of an addition to its plant in N. Walnut St., which, with equipment, will cost about $35,000.

MUNCIE, IND.—It is reported that a stock company, headed by Jerome Herff, of Peru, will construct an artificial lake, dam the creek, and build an electric power house in West Muncie.

STURGIS, KY.—This town offers a twenty-year electric light franchise for sale. Address Mark E. Eastin, Mayor.

GREENFIELD, MASS.—The Greenfield Electric Light & Power Company will submit proposals for furnishing lights in Deerfield.

HAVERHILL, MASS.—The control of the Haverhill Electric Company has passed into the hands of Malden and Boston capitalists. It is stated that the new management will make a number of improvements to the Water Street plant.

TUNICA, MISS.—The town of Tunica has made arrangements to purchase the electric light plant located there, which is now owned by private parties, and will pay $5000 for the plant.

JEFFERSON CITY, MO.—The Jefferson City Light, Heat & Power Company was sold Sept. 29 to a Chicago syndicate headed by W. N. Horner. The consideration was given as $80,000. The new management contemplates improving the plant and increasing its capacity.

HOBOKEN, N. J.—Contracts for the building of conduits underground on Washington Street, Hoboken, have been placed by the Public Service Corporation, and application will be made to the Common Council at next meeting for the permit to do the work. The conduits will be for electric light wires, electric feed wires and all other wires used on this thoroughfare by the Public Service Corporation, except the trolley wires. The telephones and telegraph companies will, in all probability, arrange with the Public Service Corporation for the use of the conduits for their wires, as the Council has passed an ordinance compelling the placing of all wires on Washington Street underground.

BUFFALO, N. Y.—The Council, desiring to stop increased expenses, has refused to provide more electric lights. All those provided are already in use.

BUFFALO, N. Y.—Papers of incorporation have been filed by a concern to be known as the Buffalo Lighting Company. The capitalization will be $30,000. The directors are Norman and Luella McMillan and John E. Wesley, all of Buffalo.

BUCYRUS, OHIO.—The Marion-Bucyrus Railway & Light Company has been incorporated with a capital stock of $250,000. The incorporators are Ellis Bartholomew, G. K. Canfield, Chas. B. Selby and G. A. Bartholomew.

EUGENE, ORE.—The Lane County Electric Light Company is preparing to install lights in Springfield. Poles are now being placed.

BRADDOCK, PA.—Braddock Borough Council has made a new contract with the Allegheny County Light Company for 120 arc lights for five years at $75 each per year.

PITTSTON, PA.—Improvements are under way at the plant of the Citizens' Electric Illuminating Company that will more than double the power that is now being generated. The work is being carried on under the direction of Architect B. A. Crowther, who drew up the plans. A new switchboard will be installed and two new Babcock & Wilcox 600-hp boilers. It is expected that the work will be completed within a few months.

FORT ETHAN ALLEN, VT.—Sealed proposals, in triplicate, will be received until 12 m., Oct. 25, for the installation of an electric lighting system, including interior wiring and fixtures, distributing system and electric current, at Fort Ethan Allen, Vt. Information furnished on application. Address Capt. T. B. Lamoreaux, Quartermaster.

OSHKOSH, WIS.—The Oshkosh Electric Light & Power Company has been purchased by interests representing the Oshkosh Gas Light Company. The property, after being in the hands of a receiver for eighteen months, was sold, August 11, at public auction for $215,000.

The Electric Railway.

NEW HAVEN, CONN.—The Middletown Street Railway Company has been sold to the New York, New Haven & Hartford Railway Company. The sale was effected at the rate of $15 per share of stock, the par value of which is $25 per share. The capital stock of the company amounts to $125,000.

PETALUMA, CAL.—The Petaluma & Santa Rosa Electric Railway Company has almost completed the equipment of its electric station at Sebastapol, Cal. The principal supply of electric power is, however, to be secured from the Bay Counties transmission lines of the California Gas & Electric Corporation. In the new station building two large transformers reduce the current from the line voltage of 40,000 volts to 2000 volts. Motor-generators will then supply direct current at 500 volts for operating the cars. A storage battery of 264 cells, installed by the Electric Storage Battery Company, is said to be capable of operating the road alone for 6 hours if necessary. In less than two months 25 miles of the new electric road will be in operation if the expectations of the constructors are realized.

HUNTINGTON, IND.—Promoters of the Portland, Montpelier, Warren & Huntington Traction Company are planning for an extension northward from the city so as to obtain traction line connections into Chicago.

VINCENNES, IND.—The Vincennes, Washington & Eastern Railway Company has filed articles of incorporation with the Secretary of State. The capital stock is $1,000,000. The company proposes to build from Vincennes to Washington and Loogootee. Austin F. Cabel, H. F. Trueblood, S. C. Eskridge, F. E. Bakeman and N. J. Padgett are the incorporators.

BOSTON, MASS.—The Boston & Worcester Street Railway Company will construct a new generating station near its power house which will be used to furnish power for the Marlboro & Framingham and cross town divisions of the system.

WESTFIELD, MASS.—Sufficient capital has been secured by the Western Massachusetts Street Railway Company for beginning operations on the construction of its lines on an extensive scale and plans have been formulated for building the road from Westfield to Huntington. It is estimated that the cost of these 12 miles of road with the power plant and all necessary equipment will be about $400,000.

HOOSICK FALLS, N. Y.—The stockholders of the Bennington & Hoosick Valley Railway Company have elected this board of directors: George E. Greene, John B. V. Quackenbush, E. E. Larrabee, Irving E. Gibson, Joseph Buckley, Levi E. Worden, F. S. Donnell, Frank H. White, Elwin H. Libby. The directors have elected the following officers: President, George E. Greene; vice-president, Joseph Buckley; treasurer, Irving E. Gibson; secretary, E. H. Libby.

BUFFALO, N. Y.—The Buffalo, Batavia & Rochester Electric Railway Company has been incorporated, capital $3,500,000. Directors: Loran L. Lewis, S. R. Mann and Spencer Kellogg, of Buffalo. The road will be 65 miles long.

DAYTON, OHIO.—The Wilmington-Hillsboro Traction Company has been incorporated, with $10,000 capital stock, by Edward G. Orr, Edward A. Yaw, W. D. Riddell, F. E. James and A. J. Miller. Construction offices have been established at New Vienna.

LEXINGTON, KY.—A motion has been entered here for a receiver for the Blue Grass Consolidated Traction Company, capitalized at $7,000,000 and managed by Senator George B. Davis, of Detroit. The action was forced by creditors of the concern, which has only partially completed its interurban system in central Kentucky.

SPRINGFIELD, OHIO.—Fred J. Green, receiver for the Springfield & Xenia Traction Company, has been ordered by the court to readvertise the property and again offer it for sale. The property was offered for sale at an appraisal of $375,000 a short time ago, but no bids were made.

LARUE, OHIO.—An engineering force is laying out the route of the proposed extension of the Delaware, Magnetic Springs & Richwood Railway from Richwood to Kenton. Actual construction work will start next spring. Work on the extension to Richwood has been started and it will be completed this fall.

SPRINGFIELD, OHIO.—The Springfield, Charleston, Washington & Chillicothe Railway Company has been organized to build an electric railway to connect the cities mentioned in its title. The officers of the company are H. L. Rockfield, president; Frank Patterson, vice-president and general manager; A. M. Winger, treasurer; E. Atkinson, secretary.

NEWHOPE, PA.—There is a movement on foot looking toward the building of an electric railway from this place to Kintnersville, where connections would be made for Easton. The distance is about 22 miles.

YORK, PA.—The York Street Railway Company and the York County Traction Company are considering plans for a reorganization and merger with a capital stock of $3,000,000. The present capital stock is about $1,500,000.

LATROBE, PA.—A new electric railway company, the Latrobe & Mount Pleasant, is being formed to build a line between these two points via Pleasant Unity, Monmouth, Hecla, Standard and all other mining towns between Latrobe and Mount Pleasant. John Hartigan, president of the Mount Pleasant Heat & Light Company, is at the head of the project. A charter will shortly be applied for.

PARKESBURG, PA.—President Thomas E. O'Connell of the Oxford, Russelville & Parkesburg Electric Street Railway has completed the negotiations for rights of way between this place and Oxford. A large building in this borough has been looked over with a view to converting it into a power house. Mr. O'Connell states that he has the financial arrangements in good shape and expects to begin construction at an early date.

NASHVILLE, TENN.—Charles Wallace Silver and other promoters of the Nashville & Lewisburg Interurban Railway, who were associated with him, it is said, have abandoned the project of building the proposed road between Nashville and Lewisburg and Huntsville, Ala., having failed to secure the necessary capital.

BRYAN, TEX.—Business men of Bryan and College have taken hold of the project of building an electric railway between the two towns. W. E. Saunders, president of the Business League, can give information in regard to the project.

AUSTIN, TEX.—An amendment to the charter of the St. Louis, Brownsville & Mexico Railway Company has been filed in the Secretary of State's office, increasing its capital stock from $1,000,000 to $3,850,000. The purpose of the increase of capital stock is to provide for the construction and equipment of additional lines of road.

OSHKOSH, WIS.—The Oshkosh & Western Electric Railway Company has been incorporated to build an electric railway from Omro to Berlin and also operate a line between Omro and Oshkosh. The incorporators are Joseph H. Porter, Oshkosh; Clement C. Smith, Milwaukee; George Hilton, Oshkosh, and C. S. Morris, Berlin. The capital stock of the company is placed at $10,000.

BERLIN, ONT.—The Berlin & Waterloo Street Railway Company proposes to build a new power house.

NEW INDUSTRIAL COMPANIES.

BAKER & COMPANY, New York, N. Y., has been incorporated with a capital of $5000. Directors: C. O. and C. W. Baker and Chas. Englehard.

THE VALENTINE ELECTRIC SIGN COMPANY, Atlantic City, N. J., has been incorporated with a capital of $25,000. The incorporators are Thos. E. Valentine, George W. Vallee and Oliver T. Rogers.

RELIANCE TURBINE COMPANY, New York, N. Y., has been incorporated with a capital stock of $10,000. Directors: E. H. Ludeman and O. H. Ludeman, New York, and H. G. Cook, Paterson, N. J.

UNITED ENGINE & POWER COMPANY, New York, N. Y., has been incorporated with a capital stock of $300,000. Directors: Rudolph Brettner, Emanuel Reubenstein and Gustav Bondy, all of New York.

THE SYRACUSE ELECTRIC COMPANY, Syracuse, N. Y., has been incorporated with a capital of $20,000, to do a general electrical business. The incorporators are Wm. H. Horton, S. J. Kelly and M. J. Myers.

THE PULSIFER & LARSON COMPANY, sign advertising, has been incorporated in Newark, N. J., with a capital of $25,000. The incorporators are Samuel Saulson, W. P. Buehler, David Weingarten and Frederick Wetzler.

DENIO SMOKE PREVENTION & FURNACE COMPANY, New York, N. Y., has been incorporated with a capital of $300,000. Directors: W. L. Denio and Marcus Hirshfield, Rochester, and G. C. Irwin, Jr., New York.

EDMONSTONE COMPANY, New York, N. Y., has been incorporated with a capital stock of $100,000, for the purpose of manufacturing telephones and appliances. The directors are Bouton Thompson, D. M. Miers and J. E. Ruston.

HOOSICK FALLS GENERATING COMPANY, Hoosick Falls, N. Y., (gas and generating plant) has been incorporated with a capital of $25,000. The directors are E. R. Case, New York City; W. Z. Roberts, Beverly, N. J., and C. P. Fitch, Deal Beach, N. J.

AMADORE RAILWAY COMPANY, of Chicago, has been incorporated at Wilmington, Del., to construct, maintain and operate railways. Capital, $1,000,000. The incorporators are Geo. H. Mahler, Jos. Sheridan and M. A. Burns, Chicago; Wm. Surman, Carlinville, Ill., and Erastus Waples, Wilmington, Del.

OBITUARY.

JOHN HOLLINGSHEAD, the well-known magazine editor and theatrical director, died in England, Oct. 10, at the age of 77 years. Mr. Hollingshead was one of the original promoters of electric lighting in England. His Gaiety Theatre was one of the very first places in London where electric lights were seen. Unless we are mistaken he used Jablochkoff candles or semi-incandescent arcs.

EDUCATIONAL.

POPULAR LECTURES.—Dr. H. M. Leipziger, supervisor of lectures for the New York Department of Education, has made provision in the course of popular lectures this year for several scientific and technical series. They include the following: Educational Alliance, East Broadway and Jefferson St., a course of thirteen lectures on Principles and Practice of Electrical Engineering, Mr. W. Wallace Ker, of Hebrew Technical Institute, Thursdays (beginning October 6th). Public School 51, 523 West 44th St., a course of ten lectures on Electricity, Prof. Charles L. Harrington, Mondays (beginning October 10th). Board of Education Hall, Park Ave. and 59th St., a course of nine lectures on Electricity and Magnetism, Prof. E. R. Von Nardroff (of Erasmus Hall High School), Wednesdays (beginning October 19th). Great Hall of the Cooper Institute, Third Ave. and 8th St., a course of six lectures on Matter, Electricity and Radiation, Prof. John S. McKay, of Packer Collegiate Institute, Wednesdays (beginning November 9th). These lectures are all freely open to the public.

PERSONAL.

MR. PETER COOPER HEWITT has returned recently from Europe and has resumed active experimental work in various lines of electrical research.

MAJOR W. A. GLASSFORD, of the Signal Corps, has been ordered to Seattle, Wash., to assume charge of the Alaskan cable system, relieving Lieut.-Colonel R. E. Thompson, who has been assigned to duty as chief signal officer in the Philippines division.

MR. J. DE SMET MAGUIRE has resigned his position as special representative of the National Electric Company of Milwaukee, to assume the presidency of the American Electric & Controller Company, with headquarters at No. 12 Dey St., New York.

MR. JOHN S. PECK, the transformer engineer of the Westinghouse Electric & Mfg. Company, Pittsburgh, sailed on Saturday for England on the "Cedric," where he will become a member of the engineering staff of the British Westinghouse Company.

MR. ALBERT G. BROWN, formerly of the General Electric Company, in New York, is associated with the Compiling Bureau, of 56 Pine Street, New York. Mr. Brown has had an experience in electrical work which will give him a special adaptibility to his new work.

MR. J. C. SMITH, manager of the Western Union Telegraph Company at Chicago, has been appointed superintendent of the newly created fourth district of that company. Mr. Smith's headquarters will be at Dallas, Tex. The new district embraces the States of Louisiana and Texas.

H. M. BYLLESBY & COMPANY have been appointed engineers and consulting managers of the Oshkosh Gas Light Company, of Oshkosh. This company has purchased the plant of the Oshkosh Electric Light & Power Company, formerly owned by the United Electric Securities Company, of Boston, Mass..

MR. BERTRAM S. GILES, M. I. E. E., who was for many years responsible for the design of Messrs. Mather & Platt's electrical machinery and acted as their technical representative and adviser, has now joined Messrs. Johnson & Phillips as manager of their electric light and power works, for the manufacture of generators, motors, transformers, resistances, switchboards, arc lamps, etc.

MR. C. G. Y. KING, on the recent occasion of his leaving the Chicago Edison Company's engineering staff after long years of service, to engage in commercial life, was given a dinner by over 50 of his friends and associates in that great corporation. Delicious features of the affair were the original drawings and caricature lantern slides to illustrate Mr. King's life in the Windy City for twelve years past.

MR. ROBERT J. WYNNE, who has just been appointed Postmaster-General by President Roosevelt, to succeed the late Henry C. Payne, was at one time a telegraph operator in Philadelphia, and later became chief operator of the Philadelphia office of the Pacific & Atlantic Telegraph Company. He was afterward, for many years, engaged in newspaper work in Washington, and is well-known among journalists.

MR. ARTHUR BALFOUR.—The English press has been lavish of its comment on Mr. Balfour's address before the British Association, and it has been amusing to notice how closely criticism and praise have followed the lines of political sympathy. The address is reprinted in *The Living Age* for Oct. 1. It is entitled "Some Reflections Suggested by the New Theory of Matter," and deals with philosophical as well as scientific questions. It is an interesting treatment of an ever-fresh subject.

MR. J. LLOYD WAYNE has resigned as instructor in the Department of Mechanical Engineering at Massachusetts Institute of Technology, to accept the position of Division Equipment Foreman in the Indiana division of the Central Union Telephone Company. Mr. Wayne, who was for some years in the construction department of the New York Telephone Company, unites a thorough knowledge of every department of telephony with executive qualities that particularly fit him for the line of work he has again taken up.

MR. JOHN J. CARTY, chief engineer of the New York Telephone Company, has undergone a severe ordeal this week in the serious accident to his wife. Mrs. Carty was out driving at Short Hills, N. J., on Monday afternoon, when her buggy was run into by a careless driver who decamped immediately. Her young son and the coachman escaped without injury, but Mrs. Carty had her collar bone broken. We are very glad to report that her condition is favorable and improving, although the shock is necessarily severe to one who has been for some time in delicate health. Mrs. Carty, who is a sister of the distinguished actress, Miss Annie Russell, is widely known in histrionic as well as electrical circles, and a host of friends pray for her early and complete recovery.

MRS. J. W. GODFREY.—Mrs. Amelia Godfrey, widow of James W. Godfrey, obtained a verdict from a jury in the Supreme Court before Judge Giegerich this week for $30,000 against the City of New York. Her claim was for $100,000 damages. Former Judge Olcott represented her and showed that while Mr. Godfrey was driving along St. Nicholas Avenue on the night of November 9, 1901, the wheels of the carriage struck a pile of paving stones that had been left unguarded, with the result that Mr. Godfrey was thrown from the carriage, striking on his head, sustaining injuries from which he died a few hours later. This award gives pleasure to a great many friends of the late Mr. Godfrey, whose untimely death was a severe blow to the electrical trade of which he was so long an active and useful member. At the time of this fatal accident Mr. Godfrey was general sales manager for the India Rubber & Gutta Percha Insulating Company, and prominent in other electrical enterprises.

Trade Notes.

THE REEVES ENGINE COMPANY, through its New York office, 85 Liberty Street, reports that during the month of September it closed engine sales to the number of 36.

DOCK LIGHTING.—In our article on dock lighting in New York by the Cooper Hewitt system, it was "typed" that the tubes used were 45 feet long. This is an obvious misprint for 45 inches, which was not caught by the proofreader.

THE ELECTRIC CONTROLLER & SUPPLY COMPANY, of Cleveland, announces the opening of its southern branch office at 509-510 Woodward Bldg., Birmingham, Ala. This company is now represented in the following cities: New York, Philadelphia, Pa., Pittsburg, Pa., Cleveland, Ohio, Birmingham, Ala., Denver, Col., San Francisco, Cal., and London, Eng.

AN ADVERTISING HANGER.—What is probably the largest hanger ever issued by an electrical company is one now being sent out by the Cutler-Hammer Mfg. Company, of Milwaukee. It is 38x50 inches, and on it is illustrated some of the standard and also some of the special apparatus made by that concern. It is arranged by bulletin numbers, and in consequence will be of almost inestimable value for ready reference.

THE AMERICAN ELECTRIC TELEPHONE COMPANY, of Chicago, reports recent shipments of switchboard equipments to the following points. U. S. Government, New York district, 25 line switchboard; Paulina, Kan., one 100 line switchboard; U. S. Government, Philippine Islands, one 100 line switchboard; Parker, Kan., one 100 line switchboard; Fort Sheridan, Ill. (U. S. Government), one 100 line switchboard; New York, N. Y., one 100 line switchboard; private shipment to Philippine Islands, one 100 line switchboard.

TURNING DOWN COMMUTATORS.—The machine put on the market by Jordan Brothers, 74 Beekman St., New York, for turning down commutators is on exhibition at the Louisiana Purchase Exposition in St. Louis in the booth of the Wesco Supply Company, in the Palace of Electricity. This device is one that permits the truing of the commutator without removing it from the dynamo. A large number of these machines have been sold and are in use in the West. The most recent shipments include filling of orders received from Canada. Great satisfaction has been expressed by many users.

THE COMPILING BUREAU, 56 Pine Street, New York, is engaged in the preparation of circulars, catalogues, and printed matter for electrical manufacturers and jobbers. The plan of the Bureau is that it will be enabled through the experience of the gentlemen composing it to prepare tasteful printed matter which will be a credit to the company over whose name it appears. It is able to do this without interfering in the slightest with the office forces of the manufacturer. Messrs. William F. Leggett and Albert G. Brown each has a record of careful, consistent work which gives assurance of the ability of the Compiling Bureau to produce good matter.

THE ELECTRIC STORAGE BATTERY COMPANY has issued a pocket book containing data in regard to storage battery work and Chloride accumulators in particular. The story in the book is divided into several departments or chapters beginning with "Characteristics of a Good Battery," and then describing the work of Chloride accumulators in railway stations, sub-stations, water power plants, central stations, isolated plants, etc. In connection with these there are shown half-tone pictures illustrating the installations and many curves are given to show the operation of the batteries under different conditions. At the back of the book are printed tables with reference to installation work.

THE BURT MANUFACTURING COMPANY, of Akron, Ohio, reports that it has recently sent one of its large oil filters to the National Steel & Wire Company, at New Haven, Conn., where it has already sold a number of its Cross oil filters. The largest concerns in the country are using the Burt Manufacturing Company's goods. The company has also sold two Warden oil filters to the Lehigh Coal Company. Two of its 150-gallon oil filters have also been sent to the LaBelle Iron Works, Steubenville, Ohio, for use in connection with an oiling system which this plant operates. This concern thinks highly of the Cross oil filters and now has quite a number in use in its mills.

THE CENTRAL ELECTRIC COMPANY, Chicago, has issued a handsome catalogue, which is devoted entirely to its lighting fixture department. The book is 9x12, contains 80 pages of fixtures, portables, glassware and trimmings, and the class of goods shown is such as will be sure to attract attention. The Central Electric Company is particularly well fitted to handle this trade, having a competent fixture man in charge of this branch of its business, as well as a special fixture display room which has been fitted up with a line of samples that give a wide selection for any prospective buyer who may happen to call. The company recently put on the market a new portable and desk lamp which was described by us some months ago and which is one of the many items illustrated in its catalogue. All central station managers and dealers who have not been remembered will do well to write for a copy.

THE MAYER & ENGLUND COMPANY, of Philadelphia, has arranged to handle the "Imperial" combination headlight. This is an arc headlight made with incandescent lamp attachment, all contained in the same case. The position of the incandescent lamp does not in any way interfere with the arc light. The headlight is also made without the incandescent attachment if desired. One of the peculiar and valuable features of this headlight is that the arc carbons are placed at an angle of 45 degs. from perpendicular; the result is that practically 85 per cent. of the total light of the arc is furnished directly to the vertex of the reflector. The feeding of the carbon is perfectly automatic, being controlled with a floating clutch, operated by a series magnet. Cutting out the arc and throwing in the incandescent lamp when city streets are reached is accomplished by the simple turning of a two-circuit snap switch.

ELECTRIC MOTORS IN MACHINE-SHOP SERVICE.—The manufacturer who contemplates installing motors for driving his machinery or machine tools, either individually or in groups, will find much valuable information on the subject in a paper recently read by Mr. Charles Day before Section B of the International Electrical Congress, recently held at St. Louis. Mr. Day is a member of the firm of Dodge & Day, engineers. The subject is one to which they have devoted much time and study, as evidenced not only by this recent contribution, but Mr. Day's other very able papers along the same line, "The Requirements of Machine Tool Operation with Special Reference to the Motor Drive," read before the New York Electrical Society, and "The Machine Shop Problem," read before the American Society of Mechanical Engineers. The large number of motor layouts this firm has made in the past few years and the installations it has engineered have given it a wide range of experience.

GILLENDER & SONS, INC., Philadelphia, Pa., have issued catalogue No. 9, which is devoted entirely to electrical and gas glassware. This book is a mammoth affair (12½x14½), bound in brown cloth with silver lettering, and contains about 125 pages, half of which are full-sized plates showing handsome, well-printed illustrations of the various styles of globes and shades which are listed. These include every imaginable shape, size and quality, from the simple, plain fixture shade to the 18-in. richly-cut ceiling bowl. As an instance of how complete this line is may be mentioned the square shades, balls and stalactites with roughened inside for use in connection with the popular style of "Mission" furnishings. Inner and outer globes for the principal makes of arc lamps are also illustrated. A specialty which is meeting with great success is the line of "Franklin double refracting electrics." These are made in seven styles, and are as brilliant as cut glass—at only a fraction of the expense.

MICA INSULATOR COMPANY, New York City, has just issued the following notice: We recently learned that a report has been circulated among the users of micanite that the Mica Insulator Company had been manufacturing what is known as "Amber Plate" by using India mica in the center with a coating of amber mica on the outside. We take this opportunity to assure the trade that these reports are absolutely false, and are only made with a view to injuring our business. Our company has been in existence twelve years, and during this period every piece of insulation that we have turned out has been exactly as represented. We have never sold any amber micanite that did not consist entirely of the best amber mica we could purchase. We guarantee all our amber plate to be made from pure, soft Canadian amber splittings. We have our splitting factory in Ottawa, and have the pick of the softest and best mica mined. We take this opportunity to request our friends not to give credence to any reports of this nature, and we believe that the reputation we have earned in the past twelve years for honesty and fair dealing will be sufficient refutation of any such malicious charges.

Record of Electrical Patents.

UNITED STATES PATENTS ISSUED OCTOBER 4, 1904.
[Conducted by Rosenbaum & Stockbridge, Patent Attys., 140 Nassau St., N. Y.]

771,222. CLIP FOR ELECTRIC SWITCHES AND METHOD OF MAKING SAME; Charles C. Badeau, Swissvale, Pa. App. filed June 1, 1903. The clip is made by longitudinally splitting a piece of tubing and flattening the separated portions.

771,235. AUTOMATIC FIRE ALARM TRANSMITTER; William L. Denio, Rochester, N. Y. App. filed Jan. 20, 1904. Details.

771,237. REACTANCE COIL; John J. Frank, Schenectady, N. Y. App. filed Feb. 2, 1903. A movable core, two concentric coils for each of two legs of the core and cross-connections between the coils such that the inner coil on each leg is in series with the outer coil on the other leg, the two sets of series connected coils being connected in multiple with each other.

771,238. MULTIPHASE TRANSFORMER; John J. Frank, Schenectady, N. Y. App. filed Feb. 6, 1904. A number of coils for each phase, connections joining one terminal of one coil of each phase to a common point, connections joining another coil of each phase to a separate common point and multiphase leads extending from the remaining terminals of said coils.

771,239. ELECTRIC SWITCH; Ernest L. Gale, Sr., Yonkers, N. Y. App. filed Feb. 8, 1904. The stationary clip is held to its base by a disconnecting device which automatically releases in case the blade sticks in the clip.

771,240. SOCKET FOR ELECTRIC LAMPS; E. R. Gill, Yonkers, N. Y. App. filed June 27, 1903. The line wires run through passages in the base of the socket and are engaged by brads connected respectively with the two metal sides of the socket.

771,246. ALTERNATING CURRENT MOTOR; Arthur W. Henshaw, Schenectady, N. Y. App. filed Feb. 11, 1903. A two-phase motor having its primary coils permanently connected in two independent windings and so arranged that by a change of the coupling of said windings to the source of current, the number of poles may be correspondingly changed.

771,249. APPARATUS FOR ELECTRIC HEATING; William S. Horry, Niagara Falls, N. Y. App. filed June 28, 1904. This invention and the one following is a plan for evenly heating a body of ore or similar mass treated in a furnace by directing the paths of the current through the mass so as to converge at a central point. The active terminals of a source of polyphase current are placed around the cylindrical surface of the mass at equidistant points from a neutral or common terminal located at the center of the mass.

771,250. APPARATUS FOR ELECTRIC HEATING; William S. Horry, Niagara Falls, N. Y. App. filed June 28, 1904. See preceding patent.

771,259. ELECTRIC FIXTURE; George L. Martin, New York, N. Y. App. filed Feb. 2, 1903. Details.

771,260. FIELD MAGNET CORE; Charles R. Meston and Herbert I. Finch, St. Louis, Mo. App. filed March 21, 1904. A field magnet core having poles of different widths and built up of laminations.

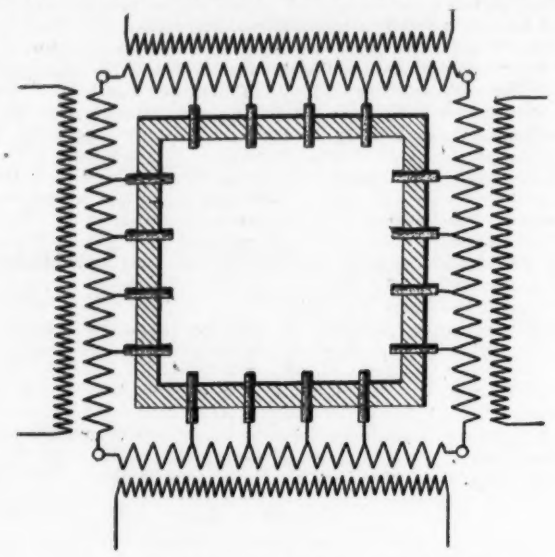
771,266. ELECTRIC METER; William H. Pratt, Lynn, Mass. App. filed Feb. 16, 1903. The rotary member immersed in mercury, is acted upon by a magnetic device in a manner to resist the upward thrust upon said member due to its immersion.

771,269. CENTRIFUGAL SWITCH; Henry G. Reist, Schenectady, N. Y. App. filed March 26, 1903. Details of a switch placed upon the end of

the shaft of an alternating current motor to automatically change the connections in starting and running.

771,274. ELECTRIC BRUSH; Albert T. Sanden and Victor Sence, New York, N. Y. App. filed Feb. 27, 1904. Details.

771,284. DYNAMO ELECTRIC MACHINE; Charles P. Steinmetz, Schenectady, N. Y. App. filed April 30, 1900. To prevent variations of line voltages due to a difference in reluctance of magnetic circuits acting in multiple, it is proposed to arrange the generating coils of the machine so that alternate coils are connected to one side of the three-wire system and the remaining coils to the other side. By this arrangement, although the voltage of individual coils may be varied, they are so grouped together that the voltage on one side of the system is always equal to that on the other.



771,250.—Apparatus for Electric Heating.

771,285. DYNAMO ELECTRIC MACHINE; Charles P. Steinmetz, Schenectady, N. Y. App. filed Jan. 25, 1904. Commutator resistance leads formed of flat zig-zag strips of resistance material with an insulating filling between them and forming a compact mass.

771,293. ALTERNATING CURRENT INDUCTION MOTOR; Andrew E. Averrett, Schenectady, N. Y. App. filed Jan. 26, 1903. Windings adapted for connection to a single phase source and arranged to produce by induction in a portion of the winding a voltage in excess of the voltage of the source, and a phase-shifting device connected to the said portion.

771,295. LIGHTING ELECTRIC TROLLEYS; Walter Burling, Grand Rapids, Mich. App. filed July 11, 1904. A lamp is attached to the upper end of the pole and automatically lighted when the wheel leaves the wire.

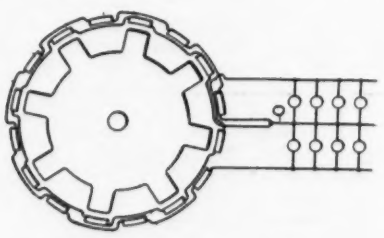
771,297. INSULATOR; Cummings C. Chesney, Pittsfield, Mass. App. filed May 16, 1903. A double tubular body with an intermediate space for liquid and having a central passage for the conductor.

771,299. APPARATUS FOR REGULATING ELECTRIC CURRENTS; Reginald C. Clinker, Rugby, England. App. filed Jan. 24, 1903. An induction regulator in which the operating mechanism is dispensed with and the rotor is free to move relatively to the stator so that it assumes a position of equilibrium dependent on the load on the system and such as to effect the required regulation.

771,300. MOLDING RECEPTACLE; Arthur E. Doscher, Jamaica, N. Y. App. filed June 8, 1903. Details.

771,307. MEANS FOR PROTECTING ELECTRIC CONDUCTORS; Edward M. Hewlett, Schenectady, N. Y. App. filed Feb. 9, 1903. Means for automatically closing an inductive circuit through an auxiliary path of resistance just before the main conductor circuit is interrupted, when a fuse burns out, to prevent injury to the insulation by the discharges of the induced current.

771,313. ELECTRIC SWITCH; Charles E. Lombard, Pittsfield, Mass. App. filed Sept. 19, 1903. Details of an oil switch.



771,284.—Dynamo Electric Machine.

771,314. PHASE TRANSFORMATION; Alexander D. Lunt, Schenectady, N. Y. App. filed July 31, 1900. The method of producing twelve-phase current which consists in combining like-phase electromotive forces derived from one phase of a three-phase system with like-phase electromotive forces derived from each of the other phases of said system, causing currents to flow in phase with said electromotive forces, and deriving twelve-phase current therefrom.

771,317. ALTERNATING CURRENT TRANSFORMER; Walter S. Moody, Schenectady, N. Y. App. filed Jan. 31, 1903. Comprises certain improvements in the arrangements of windings and their interconnection on alternating current transformers of the core type.

771,323. IRON CLAD ELECTROMAGNET; David Perret, Neuchatel, Switzerland. App. filed April 21, 1904. An ordinary spool magnet having an iron casing projecting beyond one end and inclosing a disc-like, spring-supported armature.

771,325. COLLECTOR RING; Henry G. Reist, Schenectady, N. Y. App. filed May 23, 1901. The ring has pockets around its inside periphery into which metal supporting plugs pass.

771,332. INDUCTION COIL; John Splitdorf, New York, N. Y. App. filed Feb. 23, 1904. A condenser is connected across the mechanical circuit controller and another across the vibrator.

771,334. THIRD RAIL INSULATOR; Samuel R. Stewart, Jr., Schenectady, N. Y. App. filed May 31, 1902. A U-shaped insulator fastened at its bend to the tie and at its upper ends sustaining the conducting and pick-up rails respectively.

771,343. TELEPHONE; Klas Weman, New York, N. Y. App. filed June 23, 1903.

771,344. SWITCH FOR ELECTRIC CIRCUITS; Harold C. White, Pittsfield, Mass. App. filed Nov. 23, 1903. Details.

771,346. PROTECTIVE DEVICE FOR PARALLEL FEEDERS; Leonard Wilson, Pittsfield, Mass. App. filed Nov. 2, 1903. A switching device comprising essentially opposing windings connected in the parallel feeders respectively and adapted to actuate a switch member to open the circuit of the feeder carrying the smaller current.

771,347. CONTROL SYSTEM FOR PARALLEL LINES; Leonard Wilson, Pittsfield, Mass. App. filed Nov. 20, 1903. The invention consists in an arrangement of controlling and protective devices to cut out a transmission line provided it is drawing such an excess of current as to overload the generators and also provided the parallel line or lines are in a healthy condition.

771,351. ELECTRICAL HOISTING APPARATUS; Eugene B. Clark, 2d, Chicago, Ill. App. filed Jan. 23, 1902. Automatic control for a hoisting apparatus which controls the gradual increase of the car, its slowing down and stoppage and the adjustment of the mechanism for reversing the movement.

771,410. STAGE POCKET; Benjamin Beerwald, Philadelphia, Pa. App. filed Nov. 30, 1903. The cover of the pocket is opened by merely thrusting the connecting-plug into the pocket, and it automatically closes upon the removal of the plug.

771,423. TROLLEY WHEEL; Joseph N. Drake, Cincinnati, Ohio. App. filed Dec. 15, 1903. A spring is inserted in the harp permitting the wheel to yield but tending to keep it in an upright position.

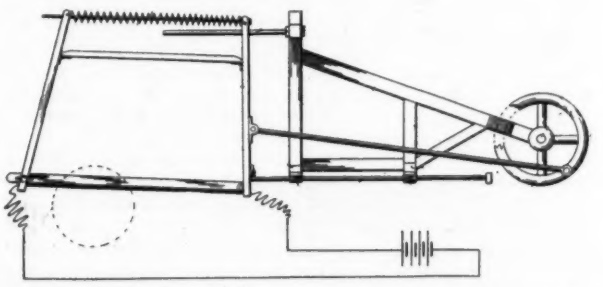
770,424. ELECTRIC HEATER; Cassius M. Fisk, Napoleon, Ohio. App. filed March 5, 1904. Details of a foot warmer or similar device having means for supporting therein a lamp or lamps.

771,468. AIR-COOLED ELECTRIC MACHINE; Leo Falk, Baden, Switzerland. App. filed Nov. 18, 1903. A fan at one end of a motor casing drives air along the radiating surfaces and finally out through an orifice.

771,472. TROLLEY HARP; John Hensley, Huntington, Ind. App. filed May 5, 1904. Contact washers on the end of contact springs are held by clips so that they will not be lost when the wheel is removed.

771,498. ELECTRIC BATTERY; Isaiah L. Roberts, New York, N. Y. App. filed Oct. 14, 1903.

771,510. SAFETY COUPLING FOR ELECTRICAL WIRES CONNECTING RAILWAY COACHES; John G. Thomas and David E. Lewis, Scranton, Pa. App. filed Oct. 2, 1903. Details.



771,518.—Electric Apparatus for Felling Trees or Sawing Wood.

771,518. ELECTRIC APPARATUS FOR FELLING TREES OR SAWING WOOD; Thomas O. Wilson, Little Rock, Ark. App. filed Jan. 30, 1904. An electrically heated wire is mounted in a saw-frame and the latter connected with a crank and pitman in a manner to be reciprocated and thus to permit of the use of the wire in the same manner as if it were a saw.

771,523. CIRCUIT CONTROLLER FOR ELECTRICALLY PROPELLED VEHICLES; Bert Aiken, Chicago, Ill. App. filed Aug. 31, 1903. An electromagnetically controlled detent automatically thrown into position to lock the controller upon the occasion of abnormal ground upon the motive apparatus.

771,533. ELECTRIC RAILWAY; Alexander Churchward, New York, N. Y. App. filed Feb. 20, 1903. A blocking system whereby a rear section of the sectional conductor is deprived of current when a car is on the next section in advance.

771,547. THERMOSTATIC FINGER PIECE FOR PUSH BUTTONS; Willis E. Harmon, Mechanic Falls, Me. App. filed Dec. 26, 1903. The fusible material controlling the circuit closer is within the button or finger piece, so that this part is the only part requiring renewal after the operation of the device.

771,563. TROLLEY CATCHER; William M. McArthur, Lockport, N. Y. App. filed May 16, 1904. Air is applied to a system which moves a rack and winds up a drum over which the trolley cord passes, whenever the trolley pole rises after leaving the wire.

771,569. SOCKET FOR INCANDESCENT ELECTRIC LAMPS; George B. Painter, Schenectady, N. Y. App. filed Oct. 9, 1899. Details.

771,646. PROCESS OF OBTAINING METALS; Franz Von Kügelgen, Holcombs Rock, Va., and Heinrich Danneel, Breslaw, Germany. App. filed July 29, 1903. (See page 658.)

771,676. TELEGRAPH CALL SYSTEM; Jesse S. Snead and William O. Ballard, Atlanta, Ga. App. filed March 17, 1904. Upon a weakening of the main line circuit, a local bell circuit is brought to a circuit-closing position and upon a restoration of the main-line current strength, the bell circuit is closed to give the signal.

771,700. VACUUM TUBE; Herman Boehm and Frederick H. Wappler, New York, N. Y. App. filed June 24, 1904. The invention has to do with the mechanical connection between the vacuum tube and a rubber handle whereby a good and strong connection is made.

771,710. SYSTEM OF ELECTRICAL DISTRIBUTION; Rufus N. Chamberlain, Depew, N. Y. App. filed March 19, 1903. A storage battery may be connected interchangeably either with the generator and booster, or with the consumption circuit.

771,749. BURGLAR ALARM; William H. Robins and John F. Jacoby, Minneapolis, Minn. App. filed April 7, 1903. Details.

771,785. ELECTRIC RAILWAY SYSTEM; William G. Lowrie, New York, N. Y. App. filed June 21, 1901. An armature carrying contact devices runs in a closed conduit in contact with two rails therein and is drawn along by a magnet carried by the car and presented to the road bed.

771,786. PHASE TRANSFORMATION; Alexander D. Lunt, Schenectady, N. Y. App. filed April 5, 1902. The apparatus patent corresponding to method patent 771,314 above described.

771,791. LAMP SOCKET; Duny A. Schutt, Peru, Ind. App. filed May 16 1901. Details.

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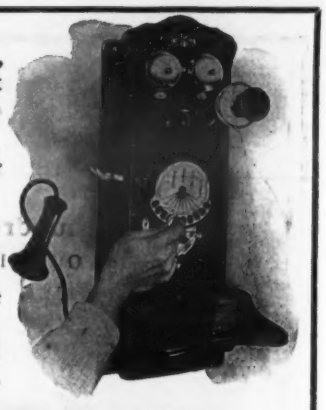

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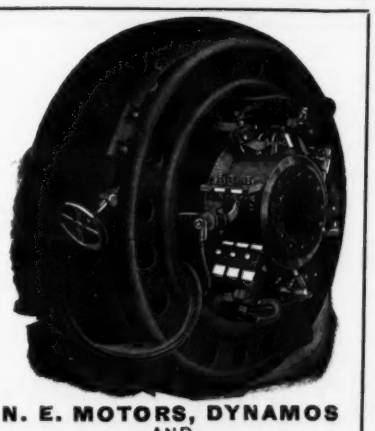

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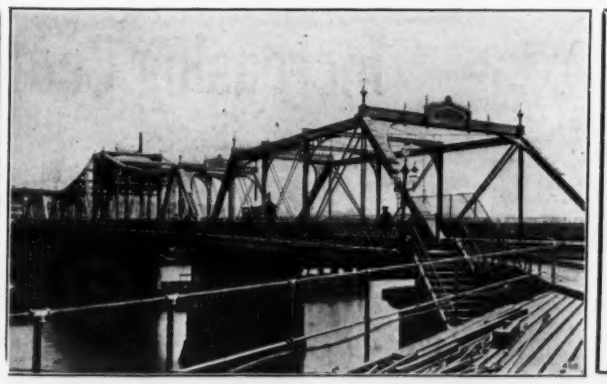

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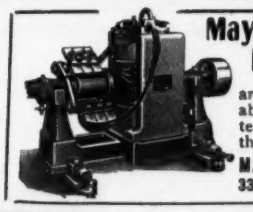

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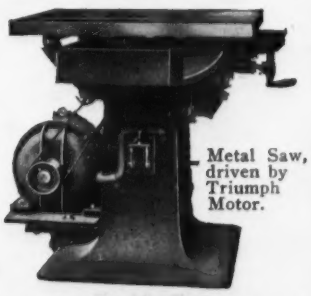

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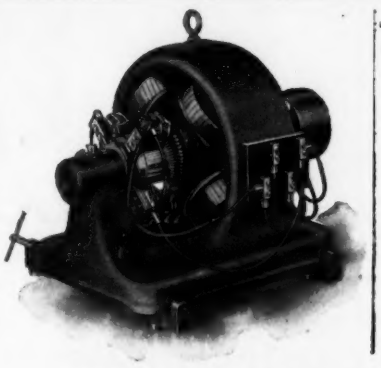

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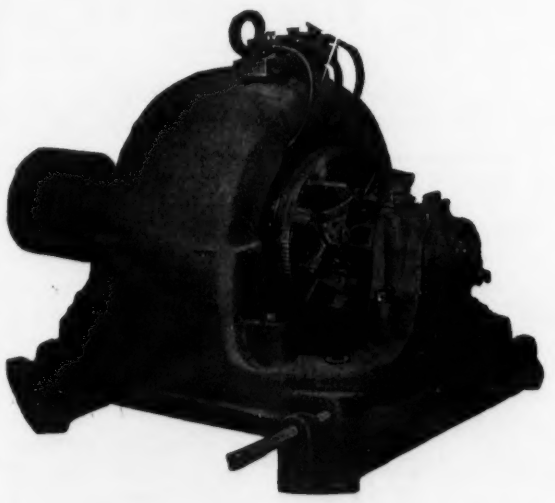

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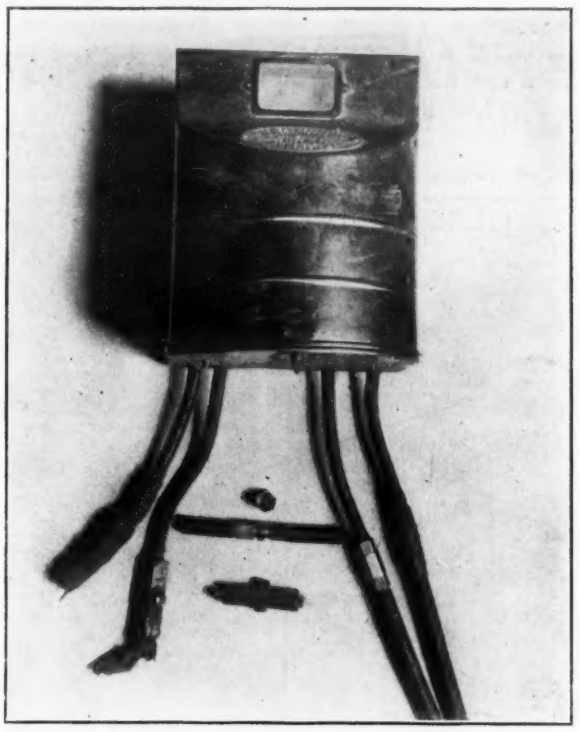

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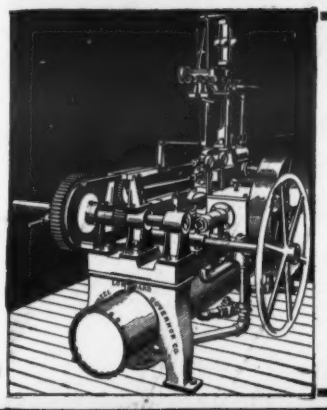

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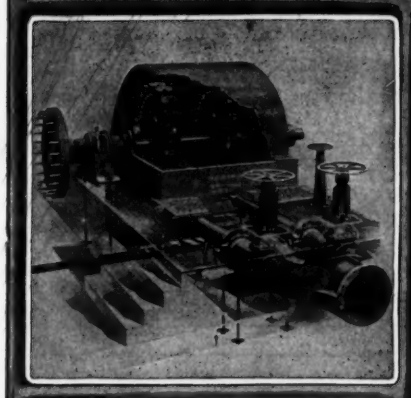

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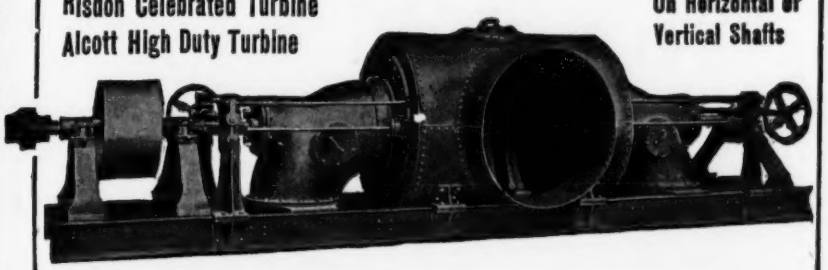

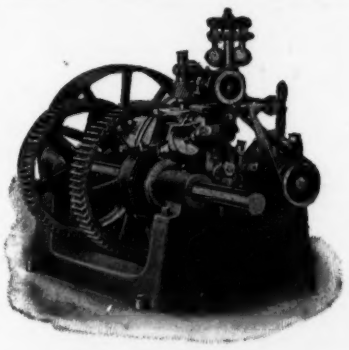

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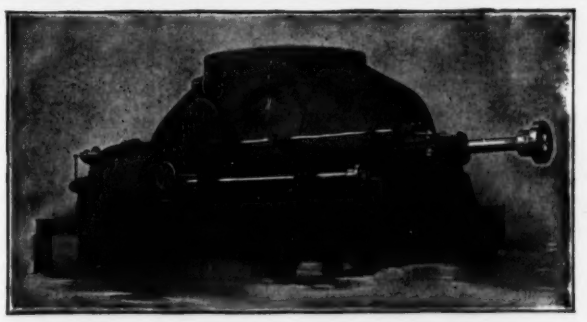

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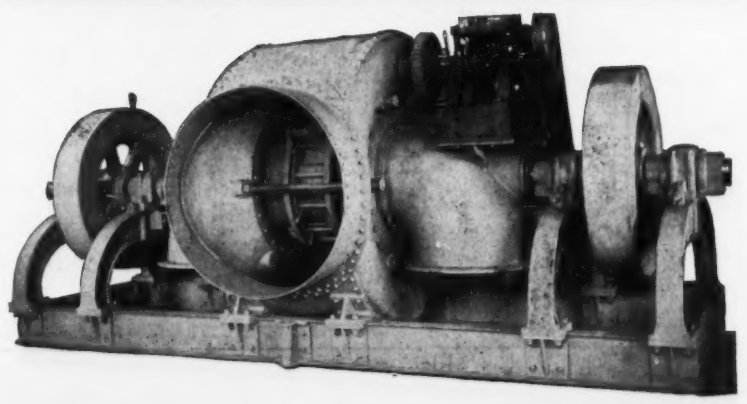

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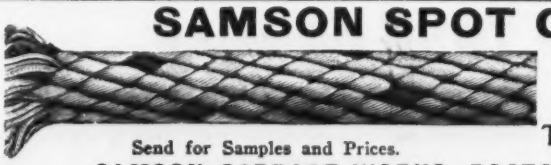

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